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Two New Genera and Four New Gobies from the Philippines and India [1]

By Albert W. C. T. Herre

THE four species and two genera here presented are but a small part of the new gobies obtained during my 1940-41 Oriental Expedition. The species with vomerine teeth have been presented in separate papers.

The study of the incredibly rich and varied gobioid fishes of the Oriental tropics has just begun, in spite of the huge number already known. No one can collect intensively in the Philippines or East Indies without finding new and unique species, as well as others which are variants of a complex of species and varieties of a central or parent stock, of great importance in studies of evolution. Tide pools, nipa and mangrove swamps, tidal flats, estuaries, reefs and fresh water streams, must all be combed thoroughly. Such exploration will not only give us new species, but will vastly increase our knowledge of geographical distribution, which at present is fragmentary.

When more and better material is secured some species will inevitably be reduced to synonymy, but this must be done only after thorough and critical examination of ample material. Certain authors have made pontifical reductions of various gobies to synonymy, after very hasty and superficial examination; sometimes they have not even bothered to take specimens out of their container! Extensive field studies, backed by ample preserved material, have shown some of the reductions to have no foundation. For example, several species of *Sicyopterus* can scarcely be told apart when in bottles. To reveal their fundamental and striking differences one must not only examine them critically with a strong lens to get the scale counts, but must examine the teeth with a compound microscope. Lack of space prevents full discussion, with illustrations, to show the fallacy of some of the published reductions to synonymy.

In several instances I have doubted the validity of a species known from but a single specimen for many years. Then collecting in a different habitat or at another time of year revealed that the species was relatively abundant, widespread, and strongly differentiated. Many kinds of gobies are so abundant and so readily kept in captivity that they are peculiarly valuable for studies of physiological adaptation, color changes, behavior, development, etc. In many places one could carry on extensive research with little equipment; rock and sand pools would provide ample material, with only a little crystal clear water over the fishes studied.

Lengths are the standard length; types of new species are in the Natural History Museum of Stanford University.

Key to the Philippine Pterelеotrii

A.– Dorsal rays 24–32; anal rays 22–32; scales about 100 to 170 ..... *Pterеleotris*

AA.– Vertical fin rays not over 18

B.– Dorsal and anal rays 10; about 165 longitudinal and 38–40 transverse scales ..... *Parviparma*

BB.– Dorsal and anal rays 15 – 18; longitudinal scales 75–100; transverse scales 20–24 ..... *Andameleotris*

1 Notes on fishes in the Natural History Museum, Stanford University; XII.

Andameleotris Herre

Andameleotris Herre, subgenus, Rec. Indian Mus., XLI, 1939: 346.

The original diagnosis is amended as follows: Dorsal VI-I-15-17; anal I-15-18; scales cycloid, 75-100 in longitudinal and 20-24 in transverse series. Head scaleless, small, blunt, the lateral eyes high up; snout very short, mouth nearly vertical; teeth in 2-4 rows above, outer row enlarged; 2 rows of minute teeth below, with one or two pairs of canines; tongue small, tip rounded. Gill opening but little wider than pectoral base, not extended forward; isthmus rather broad. A low scaleless ridge from dorsal to nape. Dorsals rather far apart, second dorsal and anal opposite and alike, their rays not divided; the caudal more or less equals head, and may be truncate, bluntly rounded, or forked in large adults.

Small fishes related to *Ptereleotris*, rather than *Amblyeleotris* as originally stated. Type of genus *Andameleotris palustris* Herre.

Andameleotris ***palustris***, new species

Dorsal I-15-16; anal I-15-16; scales in longitudinal series 85-95, plus 3 or 4 rows of fine scales on caudal base; transverse series 24; no sensory papillae on cheek; branchiostegals 5.

Body low, elongate, greatly compressed, the dorsal and ventral profiles nearly parallel, depth 6.2 to 6.5 times in length; width of the trunk two and a third times in depth; head 4.75 to 4.8 times in length; its breadth 1.75 times in depth; caudal 4.6 to 4.75; pectorals and narrow pointed ventrals about 7 in length. The large circular eye 2.85 to 3.2 times in head; the interorbital 1.4 to 1.5 in eye; the short broad snout 1.5 to 1.75 in eye. Mouth nearly vertical, the maxillary barely reaching a vertical from front margin of eye; an outer series of enlarged teeth in both jaws, with 3 rows of minute teeth behind in the upper jaw; 2 pairs of lateral canines and 2 inner rows of minute teeth in lower jaw. A row of 6 large conspicuous pores around upper half of eye. The anterior dorsal spines may be long and filiform, the third spine sometimes equal to depth and reaching origin of second dorsal. The anal and second dorsal approximately equal, their longest rays scarcely equal to the depth opposite; ventrals extend less than halfway to vent. Scales firm, adherent, in regular rows; fins naked except for caudal and pectoral bases. Anal papilla small, slender, pointed.

Color in alcohol uniform brown, the under side of head and the belly pale brownish; a black circular spot, equal to or larger than eye, on lower and basal half of caudal; fins otherwise all very pale brownish.

Described from the type, a male 23 mm. long (No. 36808, Stanford Natural History Museum), and 3 paratypes 18 to 19 mm. long (No. 36809, Stanford Museum), taken from a pool in a nipa swamp, near the Fisheries Station, Zamboanga, Philippine Islands.

Palustris, of the swamps.

Key to the Species of *Andameleotris*

A.– Uniform brown with black circular spot on lower half of caudal; other fins unmarked; caudal bluntly rounded ..... *A. palustris*

AA.– Tan, with a darker band from axil to caudal, and a circular reddish black spot on caudal base; dorsals and anal spotted; caudal with reddish longitudinal band above and below; caudal truncate or more or less forked. Habitat: Andaman Islands. ..... *A. raoi*

Yabotichthys, new genus

Dorsal VI-I-13; anal I-13; scales cycloid, adherent, regularly arranged, about 60 in longitudinal and 20-22 in transverse series; head scaleless, unarmed.

Body slender, compressed, the large head deeper and broader than trunk; mouth moderately oblique, jaws equal; eyes dorso-lateral, close together; gill opening a little wider than pectoral base, the isthmus broad. Upper teeth in 4 rows, the outer row enlarged and widely spaced; lower teeth in 2 rows, those of outer row hooked and larger than others; one or two pairs of much larger hooked canines in lower jaw. Tip of tongue rounded.

Dorsals contiguous, second dorsal and anal opposite and approximately equal; pectorals rather broad, rounded, of moderate length; ventrals rather long, their frenum very delicate, transparent, easily torn; the round-pointed caudal equals or is shorter than the head. Branchiostegals 5.

Close to *Amblygobius,* from which it differs in having cycloid scales.

Type: *Yabotichthys nocturnus* Herre, new species.

Yabotichthys ***nocturnus,*** new species

Dorsal VI-I-13; anal I-13; scales cycloid, 60-63 in longitudinal, 20-22 in transverse series; scales handsome and boldly marked under the microscope, with 10 radii, the 5 central ones complete, the others extending more or less halfway to the center; circuli 80-83.

Depth of the low wedge-shaped body 5 to 5.25 times, head 3.33 to 3.25, the rounded but pointed caudal 3.4 to 3.8 times in the length. The width of the blunt, broad head equals the depth, the breadth of trunk behind pectorals 1.5 times in depth. Both dorsal and ventral profiles taper uniformly to the caudal peduncle. Eyes very high up, in anterior half of head, equal to snout, 4.1 to 4.2 in head. Interorbital space 1.8 in eye. Nostrils rather far apart, posterior one rather large, immediately in front of eye; anterior one in a short, thin-walled, but conspicuous dark colored tubule. Mouth thick-lipped, terminal, maxillary reaching a vertical from front margin of eye or of pupil. Teeth as given already.

From lower side of eye extend 8 short vertical lines of sensory papillae, the anterior ones connecting with a line of papillae from middle to maxillary across cheek and opercle; other short lines of papillae intersect the vertical lines, forming cross bars on upper half of preopercle. Dorsals and anal low, the posterior rays just reaching caudal base when depressed, their longest rays approximately equal; the first dorsal may be lower than second dorsal and anal; first dorsal 2 to 2.8 times in head and always less than the depth. Pectoral and ventrals more or less equal, 4.5 to nearly 5 in length; least depth of caudal peduncle 3.2 to 3.33 in head or 1.3 to 1.5 times in its own length. Anal papilla of males slender, pointed, rather elongate and penis-like; very small and undeveloped in female specimens.

The type, a male 38 mm. long (No. 36828, Stanford Natural History Museum), and 20 other specimens (paratypes No. 36829), from 23 to 34 mm., were taken with a dip net while fishing with electric light at night, a kilometer or two offshore from Yabot's Camp, near San José, Busuanga, Philippine Islands. Numerous others were seen, but could not be caught. The specimens swam about freely, and evidently came from the bottom, 30 or 40 feet below. In life they were very pale yellowish, almost white, with faint markings on head and trunk, the fins colorless. In alcohol, they are very light tan, with a faint brown line from eye to eye over the nostrils, and back from the eye to below the middle of the second dorsal or beyond; three cross lines under the first dorsal, one between the dorsals, five under the second dorsal, and one over the caudal peduncle, all these connecting with the longitudinal line on the other side; a pair of brown lines between the eyes and dorsal origin, with several irregular cross lines or markings; a dusky spot (apparently violet in life) just behind middle of maxillary, widening to a faint band across cheek; a similar but broader spot on opercle, continued as a faint brown band across pectoral base and on to caudal base. Fins colorless.

Observation of these gobies, and of other fishes in various parts of the Pacific, has convinced me that most, if not all, of the alleged pelagic gobies, eleotrids, and blennies really live on the bottom, and merely come to the surface at night. Then, unless carried away by tidal currents too strong for them, they return to safety in the sand or rocks on the bottom, where they spend their daylight hours.

Nocturnus, nocturnal; in Latin poetry said of living beings that do anything at night.

Tamanka ***talavera,*** new species

Dorsal VI-I-8 or 7; anal I-7-8; longitudinal scales 44 to 46, transverse series 14; predorsal scales 22-24; scales on opercle about 30.

Form low, rather slender, with dorsal and ventral profiles nearly parallel and horizontal, the broad flat head with noticeably bulging cheeks. Depth 6.6; caudal 3.3 to 3.6; pectoral 4.1 to 4.7; ventral 6. to 6.6; head 3.3 times in length.

Mouth wide, terminal, nearly horizontal; posterior angle of maxillary under middle or hind third of eye; teeth minute, typical of the genus; tip of tongue more or less truncate or rounded when viewed from above, but indented or slightly notched when seen from below. Eye in front half of head, 4.5 in length of head; interorbital flat, more than eye and equal to snout, 4 in head. Vertical fins low, the longest dorsal spine equal to last anal ray and reaching base of first ray of second dorsal, 6.6 in length or 2 in head. The last rays of second dorsal and anal longest, the last second dorsal ray reaching caudal base when depressed, 5.5 in length. Pectoral broad, with pointed tip, reaching far beyond the short ventral, which extends less than half way to anus. Caudal broadly rounded; least depth of caudal peduncle 2.3 to 2.4 in head, or 1.6 to 1.66 in its own length. Lower part of opercle naked.

Color in alcohol dark brown, with 9 more or less irregular vertical black

bands, the first before the first dorsal, the last on the caudal peduncle; a partial one on the nape descends diagonally beneath the pectoral; a broad black crossband on caudal base, and at least three more on caudal. The largest specimens are mottled on top of the head, with a black band or two from the eye diagonally downward across the cheek. The first dorsal is dusky, with a large black blotch across its middle, especially on the posterior half, and a submarginal white crossband. Second dorsal dusky, with elongate vertical spots on the membranes between rays, and a submarginal white band; anal, pectorals, and ventrals uniform brown.

Described from the type, a male 33 mm. long, (holotype 36,824 Stanford Museum) 4 male paratypes 20 to 31 mm. in length, 4 female paratypes 28-29 mm. (No. 36,825), and 2 juvenile examples 11 and 14 mm. in length; all were taken from a nipa swamp near Capiz, Panay, Philippine Islands.

Named in honor of Florencio F. Talavera, formerly a member of my staff in Manila, and an energetic and excellent worker on fishes and mollusca of the Philippines.

Key to Philippine Species of *Tamanka*

A.– Scales 52 to 54
  B.– Body robust, uniform brown to black ..... *T. siitensis*
  BB.– Body slender, brownish yellow, with 10 brown vertical cross bars; scales in lateral series 52; transverse series 16; predorsal 25–30 ..... *T. tagala*
AA.– Scales 38 to 45
  C.– Dark brown with 9 vertical black bands; scales in lateral series 44–46; transverse 14; predorsal 22–24 ..... *T. talavera*
  CC.– Uniform dark brown; lateral scales 38; transverse 12; predorsal 20–22 ..... *T. umbra*

Ctenogobius ***perspicillatus***, new species

Dorsal VI-I-11; anal 1-10; scales in longitudinal series 30, in transverse series 12; predorsal 16.

Adult males have the depth 5.1 to nearly 5.5, the head 3.45 to 3.55, the caudal 3. to 3.2 in length. Form robust, dorsal profile nearly horizontal, ventral outline very gently curved, the body laterally compressed posteriorly; head broad, its width about 1.35 in its own length. Eye dorso-lateral, impinging upon dorsal profile, 4.33 to 4.5 in head and 1.33 in the round-pointed snout. Interorbital narrow, 2.4 in eye; postorbital a little less than half total length of head. Mouth terminal, oblique, with thick fleshy fringed lips, its angle beneath anterior third of eye; a row of 8 enlarged stout conical teeth (often partly broken or missing) at front of upper jaw; behind this a row of large teeth continuing all along the jaw; within this are 3 rows of fine teeth, reduced to 2 or even one row posteriorly; lower jaw with a short outer row of 8 to 12 teeth, terminating posteriorly in a pair of curved canines; behind are 4 rows of small teeth, reduced to 2 rows posteriorly; tongue truncate.

Two large pores in interorbital space; similar pores more or less evident around eye, along supra-opercular groove between eye and pectoral base, and along hind margin of preopercle. A curved line of sensory papillae from between nostrils to angle of mouth, giving off several branches; the first runs back below eye, then curves to and along supra-opercular groove, giving off

two branches; one runs along hind margin of preopercle, the other on front margin of opercle; the second to fifth branches extend backward upon or across the preopercle.

First and second dorsal close together, separated by 2 scales; first dorsal not greatly elongate but reaching base of second divided ray of second dorsal when depressed, its height 6 to 6.2 in length or 1.7 in head. Second dorsal and anal much alike, their posterior rays elongate; the last dorsal ray extends upon the caudal, 4 to 5.1 times in the length; the last anal ray reaches or nearly reaches the caudal base, 5.1 in the length. Pectoral broadly rounded, 3.7 to 4 times in length, extending above the anal papilla or anal origin; ventrals forming a large adhesive organ, extending to anus or beyond, 4.2 to 4.6 times in length. Caudal large, more or less rounded to pointed. Least depth of caudal peduncle 1.33 to 1.5 in its own length, or 2.16 to 2.25 times in head. Anal papilla of males elongate, with attenuate point, 2/3 to 5/6 an eye diameter in length; that of females short, blunt, with feebly notched tip in immature specimens. Gill openings not extended forward, the isthmus broad.

Color in alcohol dusky gray or greenish gray, darker above than below; a blue or blue-black bar, one to 3 scales wide, extends from eye backward over 12 to 14 scales, ending above pectoral; a crescent-shaped band of same color in front of and between eyes. In life a series of five dark crossbands over the back, with five alternating dark spots along middle of side, largely disappearing in preserved specimens. The anal, ventrals or median ventral rays, and membranes between central pectoral rays dusky, the other fins colorless, or their rays more or less darkened. A unique species, strongly differentiated by its color pattern from any other Indo-Pacific goby.

Described from the type, a male 93 mm. long (No. 36810, Stanford Natural History Museum), 6 male paratypes 54 to 92 mm. in length, and 5 immature female paratypes 60 to 74 mm. in length (No. 36811, Stanford Natural History Museum). They were taken from the salt water creek east of the steam ferry at Vizagapatam, Madras Presidency, India. This creek connects the harbor and lagoon behind Vizagapatam with the Bay of Bengal; the specimens came from near the base of the bluff at the entrance to the harbor.

Perspicillatus, spectacled, in allusion to the markings.

According to Koumans' arrangement of goby genera, this species would belong to *Acentrogobius* Bleeker. This may be a perfectly good genus as conceived by Bleeker, but as defined by Koumans it is a catch-all, containing highly divergent and heterogenous species. Koumans places together fishes with and without free pectoral rays like silk floss, although this has always been regarded as a character of primary generic importance. He likewise brings together species with the sides of the head scaled, partially scaled, or entirely naked, another incongruous assemblage. It is therefore necessary to reject the grab-bag arrangement of *Acentrogobius* by Koumans, and wait until the genus is properly revised.

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Some Factors to Consider in the Choice Between Standard, Fork, or Total Lengths in Fishery Investigations

By KENNETH D. CARLANDER and LLOYD L. SMITH, JR.

INTRODUCTION

METHODS of measuring fish during fishery investigations have shown a marked lack of uniformity in recent years. Although standard length was used almost universally in earlier studies, many investigators are now turning to total or fork length instead of standard length.[1] The principal advantage of standard length is that much of the data now available on many fisheries is expressed in that dimension. Also, many investigators believe it to be more representative of the actual size of the fish than are other measurements. However, Royce (1942) indicated that total length is more representative of weight than is standard length. The present study fails to substantiate this finding.

Standard length is not as easy to measure in the field as are fork or total lengths because it is difficult to determine the exact point of the body at which it is to be measured. The present study indicates that total length can be measured more accurately than standard length. Fork and total lengths also have an advantage in that they are commonly used by commercial and sport fishermen, whereas standard length is usually understood only by scientific workers. Total length is more widely used than fork length.

This investigation was undertaken to determine which type of measurement can be made most accurately and which is most closely correlated with weight. Three species of fishes, *Pomoxis nigro-maculatus* (Le Sueur), *Perca flavescens* (Mitchill) and *Stizostedion vitreum vitreum* (Mitchill), were examined and each sample included from 98 to 150 specimens covering a wide range of sizes.[2] Fish were placed flat on the measuring board so that the tip of the snout or jaw with the mouth closed was firmly against the end board. The following measurements were then recorded to the nearest millimeter for each fish:

Standard Length A, to the end of the flesh on the caudal peduncle.
Standard Length B, to end of hypural plate, determined by bending the caudal fin and noting the crease.
Standard Length C, to end of the flesh on the caudal peduncle.
Fork Length, to center of fork of caudal fin.
Total Length, to tip of caudal fin with the two lobes squeezed together.

All measurements, except standard length A, were made with a triangle placed against the back of the measuring board to extend the line from the fish to the ruler. In standard length A, this extension was made by eye. Measurements were made for each fish by five different investigators. Weight was recorded to the nearest gram. Statistical treatment was patterned after that of Treloar (1939).

1 Standard length is measured from the tip of the snout to the end of the body exclusive of the caudal fin. Fork length is measured from the tip of the snout to the center of the fork of the caudal fin, and total length is the distance from the tip of the snout to the end of the caudal fin.

2 *P. nigro-maculatus*, 150 fish ranging from 119 to 295 mm. and 21 to 426 grams; *Perca flavescens*, 100 fish ranging from 163 to 268 mm. and 60 to 292 grams; *S. v. vitreum*, 98 fish ranging from 321 to 511 mm. and 296 to 1,227 grams.

Comparison of Accuracy in Measurement

In order to determine which measurement could be made most accurately, the mean and standard deviation for each type were determined for each fish. The standard deviations were then averaged to provide an index of variation for each type of measurement (Table I). The significant differences [3] in the accuracy with which the various measurements can be made are as follows:

Total length is more accurate than any of the standard lengths in crappies and perch, than standard lengths A and C in walleye pike, and than fork length in crappies. It is inferior only to fork length in walleye pike.

Fork length is more accurate than either total length or standard lengths A and C in walleye pike, and more accurate than any of the standard lengths in perch. It is less accurate than total length or standard length B in crappies.

The three methods of measuring standard length do not appear to differ significantly in accuracy except that standard length B appears to be more accurate in walleye pike. Standard length C differed from standard length A only in the use of the triangle as an aid in measuring. Apparently, the use of the triangle does not give significantly more accurate results.

In the walleye pike, measurements of total length were more accurate than those of standard length, but as accurate as those for standard length B. Standard length is also less accurate than fork length except in the crappies where fork length is inferior.

Table I

The Mean Standard Deviations for Various Length Measurements, as Measured by Five Investigators

(*Standard deviations around these means are indicated by* ±)

Measurement	*Crappies*	*Perch*	*Walleye Pike*
Standard Length A	1.3851 ± 0.5604	1.6716 ± 0.5155	2.2710 ± 0.8254
Standard Length B	1.2861 ± 0.4516	1.5717 ± 0.3610	1.7613 ± 0.8627
Standard Length C	1.3573 ± 0.5254	1.5296 ± 0.3504	2.3538 ± 0.8390
Fork Length	1.4260 ± 0.5967	1.3320 ± 0.3435	1.5796 ± 0.7179
Total Length	1.1403 ± 0.5105	1.2928 ± 0.3211	1.8392 ± 0.7827

From these data it appears that total length measurements are most satisfactory for fishery investigations. Differences in the accuracy of measuring fork and total lengths of walleye pike do not seem large enough to justify making the walleye pike an exception to general measuring practices. In actual field work it is expected that the relative accuracy of total length measurement would be even greater than in laboratory studies.

Comparison of Accuracy in Estimating Weight from the Various Lengths

In order to determine whether total length truly represents the size of fish, correlations between weight and the various length measurements were calculated. It has been demonstrated that the length-weight relationship in many

[3] Probability that the differences in the mean standard deviations were due to chance was determined from tables of k in Treloar (1939). It is realized that this test is not entirely valid since it is known that standard deviations are not normally distributed. It is believed, however, that the results are relatively accurate. Wherever differences were considered statistically significant the probabilities were less than 0.02 and usually were less than 0.001.

species is a logarithmic straight line. The weights and lengths in the present experiments were therefore converted to logarithms before calculating the coefficients of correlation (Table II). Lengths used for each fish were the averages of measurements made by five investigators. The correlations between the various lengths and weight were all high with no significant differences.

Coefficients of variation [4] indicate that the standard error in estimating

TABLE II

COEFFICIENTS OF CORRELATION BETWEEN WEIGHT AND THE VARIOUS LENGTH MEASUREMENTS

Measurement	*Crappie*	*Perch*	*Walleye Pike*
Standard Length A	0.9888	0.9653	0.9794
Standard Length B	0.9890	0.9628	0.9763
Standard Length C	0.9891	0.9644	0.9780
Fork Length	0.9885	0.9697	0.9794
Total Length	0.9887	0.9673	0.9763

weight of fish from their lengths is only slightly over 1 per cent of the weight when the regression line is based on 100 to 150 fish. There is little difference in the magnitude of these errors when the various methods of measurement are used. Apparently the various length measurements give equally accurate estimates of weight, and, therefore, it seems advisable to use the measurement which can be most accurately made.

RELATIONSHIP BETWEEN STANDARD, FORK, AND TOTAL LENGTHS

The use of the various methods of measuring fish lengths frequently makes it necessary to convert data secured with one type of measurement to another type of measurement. Table III contains average conversion factors for a number of Minnesota fishes and also for some other fresh-water species. It must be recognized that the correlation between the various measurements is not perfect and, therefore, some errors occur in making conversions. Furthermore, there is evidence that the relationship between the various lengths is not always the same in all waters and that the relationship occasionally varies with sex (Hile, 1941). In some species the relationship between the various length measurements is constant throughout life while in others the ratio of caudal fins to total length changes as size increases. Application of the statistical methods of Harris (1909) to the foregoing data indicates that in perch, walleye pike, and crappies the caudal fin becomes proportionately shorter as the fish increase in length.

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The authors wish to express their appreciation to all who helped in this study. Dr. John B. Moyle, Mr. Laurence E. Hiner, Mr. John Dobie, and

[4]

	Crappie	*Perch*	*Walleye Pike*
Standard Length A	1.0872	1.0872	1.0603
Standard Length B	1.0863	1.0903	1.0646
Standard Length C	1.0864	1.0883	1.0623
Fork Length	1.0886	1.0813	1.0601
Total Length	1.0876	1.0846	1.0646

TABLE III

FACTORS FOR CONVERTING STANDARD LENGTH TO FORK OR TOTAL LENGTHS FOR A NUMBER OF FRESH-WATER FISHES

Species	Locality	Standard length in millimeters	Number measured	Multiply standard length by: to get fork length	Multiply standard length by: to get total length
Osmerus mordax	Michigan (Beckman, 1942)	80–230	241		1.165
Leucichthys artedi	3 Wisconsin lakes (Hile, 1936)				1.19
	2 Wisconsin lakes (Hile, 1936)				1.18
	Minnesota lakes	100–349	2,537	1.071	1.186
	Lake Superior	200–299	142	1.049	
Leucichthys zenithicus	Lake Superior (Van Oosten, 1937)				1.214
Leucichthys reighardi	Lake Michigan (Jobes, 1943)	160–209	384		1.196
		210–249	6,423		1.182
		250–319	764		1.178
Coregonus clupeaformis	Minnesota	250–550	69	1.067	1.180
	Lake Champlain, N.Y. (Van Oosten and Deason 1939)	300–499	257		1.19
		500–599	36		1.18
	Lake Huron (Van Oosten, 1939)	under 250	37		1.182
		250–550	1,495		1.175
		over 550	50		1.163
Salmo trutta fario	Minnesota	130–159	10		1.175
		160–169	31		1.146
		170–229	1,184		1.134
		230–299	265		1.126
		over 300	5		1.106
Salvelinus fontinalis	Minnesota	120–159	46		1.136
		160–199	431		1.124
		200–279	23		1.102
Cristivomer namaycush	Lake Michigan (Van Oosten and Deason, 1938)				1.192
Catostomus commersonnii	Minnesota	100–199	22	1.117	1.193
		200–299	121	1.107	1.177
		300–399	450	1.099	1.177
		over 400	104	1.095	1.169
Moxostoma aureolum	Lake of the Woods, Minnesota	0–99	9	1.124	1.240
		200–299	7	1.114	1.213
		300–499	163	1.097	1.184
Ameiurus spp.	Minnesota	100–350	785		1.135
Esox lucius	Minnesota	200–499	894	1.078	1.141
		over 500	511	1.078	1.133
	Wisconsin (Van Engel, 1940)		41		1.13
Perca flavescens	Minnesota	0–119	806	1.116	1.170
		120–199	1,278	1.108	1.160
		200–239	878	1.108	1.152
		over 240	390	1.102	1.145
	Minnesota	males 130–209	24	1.156	1.214
	Standard length B[1]	females 130–229	76	1.151	1.206
	Saginaw Bay (Hile & Jobes, 1941)	under 175	248		1.177
		175–239	996		1.155
		over 239	167		1.141
Stizostedion canadense	Lake of the Woods, Minnesota	50–450	1,888	1.102	1.159

TABLE III (CONTINUED)

FACTORS FOR CONVERTING STANDARD LENGTH TO FORK OR TOTAL LENGTHS FOR A NUMBER OF FRESH-WATER FISHES

Species	Locality	Standard length in millimeters	Number measured	Multiply standard length by: to get fork length	Multiply standard length by: to get total length
Stizostedion vitreum	nnesota	0–199	127	1.101	1.168
		200–299	466	1.093	1.160
		300–399	2,630	1.093	1.153
		400–499	320	1.088	1.153
		over 500	24	1.088	1.142
	Wisconsin (Schloemer and Lorch, 1942)				1.184
	Red Lake, Minnesota	260–360	85	1.132	1.205
	Standard length B[1]	360–430	13	1.126	1.196
Micropterus dolomieu	Wisconsin (Bennett, 1938)	90–420	188		1.18
Huro salmoides	Minnesota	0–149	21	1.132	1.196
		150–249	170	1.132	1.170
		250–349	65	1.120	1.159
		over 350	9	1.111	1.150
	Illinois (Thompson and Bennett, 1939)	5[illegible]–127			1.236
		128–203			1.226
		204–279			1.211
		280–356			1.205
		357–432			1.192
Lepomis gibbosus	Minnesota	70–129	155	1.146	1.196
		130–189	218	1.129	1.181
Lepomis macrochirus	Minnesota	0–99	136	1.178	1.247
		100–159	155	1.164	1.225
		160–189	45	1.152	1.205
		190–219	17	1.137	1.193
Ambloplites rupestris	Minnesota	100–149	80	1.157	1.207
		150–249	337	1.157	1.193
	Michigan (Hile, 1941)	under 100	29		1.222
		males over 100	136		1.217
		females 100–159	109		1.217
		females over 160	32		1.206
Pomoxis n[illegible]ro-maculatus	Minnesota	90–130	40	1.247	1.308
	Standard length B[1]	131–170	70	1.242	1.299
		171–210	40	1.229	1.289
	Minnesota	0–99	60	1.200	1.270
		100–149	91	1.186	1.241
		150–199	208	1.172	1.230
		200–249	75	1.172	1.216
		over 250	9	1.154	1.209
Aplodinotus grunniens	Lake E[illegible]e (Van [illegible]osten, 1938)	75–99	5		1.302
		125–149	44		1.276
		150–174	688		1.274
		175–199	398		1.265
		200–224	42		1.258
		225–249	35		1.255
		250–274	27		1.246
		275–299	49		1.250
		300–324	79		1.242
		325–349	85		1.233
		350–374	81		1.226
		375–399	27		1.222
		400–424	10		1.217

[1] Most Minnesota standard length measurements were made to the end of the flesh on the caudal peduncle. Where standard length B is designated, the measurement was made to the end of the hypural plate.

Miss Audrey Brennan, all of the Bureau of Fisheries Research, assisted in the measurements. Special thanks are due Dr. Alan E. Treloar of the University of Minnesota for advice on statistical treatment.

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Corrected Distributional Records for Minnesota Fishes

By Carl L. Hubbs

ERRONEOUS distributional records are among the most difficult items to correct. Once published they often persist despite all contrary efforts, and even after long abandonment they may again reappear. The more often the errors have been repeated and the longer they have remained uncorrected, the more difficult it is to put the record straight. With these ideas in mind I offer several reidentifications of fishes from Minnesota. These changes restrict the assigned ranges of the species in the state. In particular, records of southern species from Lake of the Woods on the Canadian border are shown to have been based on misidentified specimens of northern kinds. These erroneous records have led to false assumptions on the routes taken by the species in the Postglacial reinvasion of northern regions (Greene, 1935).

One species, *Notropis percobromus* (Cope), hitherto confounded with *N. atherinoides*, is added to the Minnesota state list, recently compiled by Eddy and Surber (1943).

Thanks are due Dr. Leonard P. Schultz of the National Museum and Dr. Samuel Eddy of the University of Minnesota for the privilege of examining specimens that formed the basis of the erroneous records, and for other cooperation. Dr. Lloyd L. Smith, Jr., of the Minnesota Department of Conservation, has furnished other information and specimens. Dr. Reeve M. Bailey has furnished similar assistance.

Amia calva Linnaeus

This southern species probably does not occur in Lake of the Woods. It was reported as "probably not uncommon" in that lake by Evermann and Latimer (1910: 129), but these authors recorded no specimens or definite localities and probably based their statement on hearsay. Dr. Samuel Eddy writes that *Lota lota maculosa* is generally known as "dogfish" by the Lake of the Woods fishermen, and he suspects that the *Amia* record was based on reports of "dogfish." According to him and to Dr. Lloyd L. Smith of the Minnesota Department of Conservation no bowfins have been found among hundreds of net catches examined at the lake by the state crews during 4 years of the Lake of the Woods survey. Dr. J. R. Dymond writes that he recently made extensive inquiries at Lake of the Woods regarding the occurrence of bowfin in that water, and obtained apparently reliable indications that the species is unknown there to fishermen and fish buyers of long experience in the region. Although one fisherman claimed to Dr. Eddy that he had taken bowfins in Rainy River, the main tributary stream, it may be assumed, pending further evidence, that *Amia* does not occur in the Lake of the Woods region. The record was questioned by Hubbs and Lagler (1941: 27) and regarded as probably erroneous by Hinks (1943: 18), but was accepted by Greene (1935: 28) and by Eddy and Surber (1943: 67).

There is now no good reason for assuming, as Greene did, that this species made use of the Lake Agassiz and St. Croix outlets.

Carpiodes forbesi Hubbs

There appears to be no satisfactory basis for the inclusion of this species in the Minnesota list. It is discussed here because it was treated by Eddy and Surber (1943: 106) in their "Northern Fishes," which is really an account of the fishes of Minnesota. It may occur in southern Minnesota, in the Mississippi River and main tributaries, but there are no records. The large specimens from Lake of the Woods mentioned as "possibly *C. forbesi*" are almost surely referable to *Carpiodes cyprinus thompsoni* Agassiz (the northern, small-eyed subspecies of *C. cyprinus*). Dr. Lloyd L. Smith reports (by letter) that the state survey crew frequently took *C. c. thompsoni* but no other form of the genus in Lake of the Woods.

Some confusion has arisen from the circumstance that *Carpiodes forbesi* Hubbs (1930b: 13–15) was based on the species misidentified by Forbes and Richardson (1909 and 1920: 75, 79–80, fig. 20) as *C. thompsoni*. *C. forbesi* has since been found to be characteristic of the Great Plains streams. for numbers have been taken during fish surveys in Wyoming, Nebraska and Iowa, respectively by James R. Simon, Raymond E. Johnson and Reeve M. Bailey. In eastern Iowa it has been collected as far north as Muscatine County. *C. forbesi* differs from *C. cyprinus* in its slenderer form, lower and more posterior dorsal fin, longer head and larger mouth. In the little-produced anterior dorsal rays it resembles *C. carpio* but in other respects is closer to *C. cyprinus*.

In this connection I may note that the young fish figured as *Carpiodes carpio carpio* by Eddy and Surber (1943: fig. 15) can hardly have been a representative of that species. The scales as shown are too numerous (about 40 in lateral line count) and the dorsal rays too many (about 30). The mouth is too far forward and various proportions are not typical of *C. c. carpio*. Apparently the fish was a young buffalo, likely *Ictiobus niger* (Rafinesque). Dr. Eddy reports that the present whereabouts of the specimen are unknown.

Hypentelium nigricans (LeSueur)

Records for *Catostomus nigricans* by Evermann and Goldsborough (1907: 93), repeated by Evermann and Latimer (1910: 130), are the basis for the inclusion of Lake of the Woods in the range of *Hypentelium nigricans* (Halkett, 1913: 59; Green, 1935: 60; Hubbs and Lagler, 1941: 42; Eddy and Surber, 1943: 113; Hinks, 1943: 41). The occurrence of this species so far north seemed so questionable that I have recently examined the material listed in the reports cited. All of the specimens involved (2 from Oak Island, 9 from Stevens Point and 2 from Rat Portage) were located in the National Museum. Without exception all proved to be *Catostomus commersonnii commersonnii* (LeSueur). *Hypentelium nigricans* is presumably confined in Minnesota to the southern part of the state. In Wisconsin (Greene, 1935: map 17) it extends far to the north, but only in the Mississippi and Lake Michigan drainages. In Michigan it is confined to the Lower Peninsula from the Au Sable and White rivers southward and to the Green Bay Drainage.

The evidence that this species passed through the outlets of glacial lakes Agassiz and Duluth (Greene, 1935: 61) now vanishes.

Extrarius aestivalis hyostomus (Gilbert)

Through some slip in writing Eddy and Surber (1943: 132) made it appear that Evermann and Latimer reported this fish from the Lake of the Woods drainage. The species referred to by those authors (1910: 131) was *Rhinichthys cataractae*. I have re-examined their specimens of *Rhinichthys* and find that they were properly identified. The current identifications are *R. artratulus meleagris* Agassiz and *R. cataractae cataractae* (Valenciennes).

Notropis rubellus (Agassiz)

The rosyface shiner is another species which has wrongly and repeatedly been reported as ranging northward to Lake of the Woods, on the basis of the records by Evermann and Goldsborough (1907: 97) and by Evermann and Latimer (1910: 131). Their specimens of *"Notropis rubrifrons"* from Rapid River and Asmus Point prove, on re-examination in the National Museum, to be *Notropis atherinoides atherinoides* Rafinesque. These erroneous records were the only basis for the inclusion of Manitoba in the possible range of the species (Hinks, 1943: 52).

TABLE I

USUAL DISTINCTIONS BETWEEN *Notropis atherinoides atherinoides* (FROM LAKE ERIE) AND *N. a. acutus* (FROM LAKE MICHIGAN)

	Notropis a. atherinoides	*Notropis a. acutus*
Body averaging.....	Deeper and thinner	Slenderer, more terete
Width of body in well-preserved specimens[1]..	Less than one-half of depth or of head length; 1.4 to 2.0, typically 1.6 to 1.8 in length of depressed dorsal	More than one-half of depth or of head length; 1.2 to 1.7, typically 1.4 to 1.5 in length of depressed dorsal
Head length.....	A little less than or about one-fourth standard length[2]	Much less than one-fourth standard length
Depressed dorsal.....	A little more than one-half distance to occiput	A little less than one-half distance to occiput
Upper jaw in head.....	About 3.6 to 3.8	About 3.3 to 3.5

1 The terete body of *N. atherinoides acutus* becomes slab-sided in old alcoholics.
2 This distinction does not hold in the Southwest, where the head may be very short.

The apparent use of the Lake Agassiz outlet by *N. rubellus*, in its Postglacial redispersal (Greene, 1935: 111), is not dispelled, for the records by Woolman (1896: 370) from the Red River system in Minnesota and North Dakota, listed under the identification of *Notropis dilectus* (Girard), were accompanied by color notes which make it rather sure that he had *N. rubellus*. His specimens could not be relocated in the National Museum by Dr. Leonard P. Schultz.

The identifications referred to above call for some explanation. *Notropis rubellus* was known to Woolman and other writers of his time as *Notropis dilectus*, although the two types of *Alburnellus dilectus* in the National Museum (No. 71) prove on re-examination to be referable to *Notropis atherinoides atherinoides*. The species was then long known as *Notropis rubrifrons* (Cope), which has been shown to be a synonym of *Notropis rubellus* (Hubbs and Brown, 1929: 34–35; Hubbs, 1930a: 430–431).

The subspecies *Notropis atherinoides atherinoides* (Rafinesque) is now shown, by a study of topotypes from Lake Erie, to be more similar to the southern river forms than to the Great Lakes type proper (represented most typically by Lake Michigan material). The Lake Michigan race, which we have hitherto called *N. a. atherinoides,* is obviously modified for pelagic life. It differs from topotypical material from Lake Erie as indicated in Table I.

Provisionally the wide-spread river form is identified with *N. a. atherinoides,* although additional subspecies may be recognized when the group is thoroughly studied. The Lake Michigan race may be called *Notropis atherinoides acutus* (Lapham, 1854). Since Lapham's recognizable description and figure of *Alburnus acutus* have been universally overlooked, and were published in a rare journal, his account is here transcribed:

ALBURNUS ACUTUS (*Sharp-tailed Minnow*),
From the Milwaukee River.

By I. A. Lapham

Read before the Cleveland Academy of Natural Sciences.

That part of the Milwaukee river extending to the first dam is usually filled with a small fish known by the universal name of minnow, and supposed by many to be the young of some larger species of fish. They are collected in large quantities and boiled for the sake of the abundant oil they afford, and sometimes they are used as food! They are found a few inches below the surface of the water, and always headed up the stream. Their number in this river can be stated only in millions.

This little fish belongs to the genus Alburnus, and I propose to call it *A. acutus,* from the sharp pointed lobes of the caudal fin, by which, besides other important characteristics, it may be distinguished from *A. Rubellus,* Agassiz,* and from *A. nitidus,* Kirtland.† The general form and proportions of the fish are quite similar to those of the two species referred to, but the head has a remarkable contraction above the upper lip, as shown in the figure:

[Figures here show caudal fin and head, obviously of *Notropis atherinoides.*]

Another peculiarity is the very numerous minute black dots scattered profusely over all the upper portions of the fish, being most numerous and crowded along the back, posterior to the dorsal fin.

Length 2¾ to 3¾ inches.

* Agass. L. Superior, p. 364. pl. 3, figs. 1, 2 and 3.
† An. of Science, vol. 2, p. 44.

These conclusions regarding the subspecies of *Notropis atherinoides* were briefly stated by Hubbs and Lagler (1943: 78).

Notropis percobromus (Cope)

Part of the complex from the Mississippi River system which has been passing under the name of *Notropis atherinoides* represents a fully distinct species, *Notropis percobromus* (Cope), which I have just found to range northward in the Mississippi River to Lake Pepin, Minnesota. This species becomes commoner westward and throughout most of Oklahoma wholly replaces *atherinoides.* It is the form listed as "*Notropis* species" by Hubbs and Ortenburger (1929a: 34; 1929b: 86) from Coldwater Creek, Oklahoma, but is not the southern representative of *N. rubellus* with which Hubbs and Ortenburger (1929b: 83–85) associated Cope's name *percobromus.* The

range of *percobromus* extends from the Red and Arkansas river systems on the Great Plains of Oklahoma and Kansas to the Mississippi River in Tennessee, northward through Nebraska (collected by Raymond E. Johnson), Missouri (secured in survey by George V. Harry) and Iowa (recently taken by Reeve M. Bailey) to the Missouri River system in the Dakotas and to the Mississippi River between Minnesota and Wisconsin.

TABLE II

USUAL DISTINCTIONS BETWEEN *Notropis atherinoides atherinoides* AND *Notropis percobromus*

	Notropis atherinoides atherinoides	*Notropis percobromus*
Depressed dorsal in distance from dorsal to occiput	1.8 to 2.1	1.4 to 1.85
Head depth in head length	About 1.6	About 1.4
Eye in depth (over curve)	About 3.0	About 4.0
Location of eye	A little above middle of head	At middle of head (dorsoventrally)
Body and head	Slenderer	Deeper
Eye	Larger	Smaller
Dorsal scales	More evident (dark pigment mostly on margins of pockets)	Less evident (melanophores more scattered)
Lips anteriorly	Conspicuously blackened	Less darkened
Head usually	Less than ¼ standard length (in river race)	Greater than ¼ standard length

Notropis percobromus is a pale-colored fish, without red, as befits its life in silty waters. It has an elliptical rather than oval shape, and other features that place it nearer *atherinoides* than *rubellus*. It may be distinguished from *atherinoides* by the series of characters outlined in Table II. Any one of the distinctions may fall down but the ensemble of characters holds. The two forms commonly occur together without evidence of intergradation, and are regarded as specifically distinct.

Notropis umbratilis cyanocephalus (Copeland)

The northern redfin shiner is another fish which was erroneously recorded from the Lake of the Woods region by Evermann and Latimer (1910: 131). The one specimen from Rat Portage off Caney Island (USNM, No. 64872) was found on re-examination to be *Hyborhynchus notatus*. The series from Rapid River (USNM, No. 64863) proved to be *Notropis cornutus frontalis*. Those species were found to be common in the Lake of the Woods drainage by Evermann and Latimer, but *Notropis umbratilis* is not to be expected so far north. Nevertheless the record was accepted by Greene (1935:115), Hubbs and Lagler (1941: 57), Eddy and Surber (1943:139), and Hinks (1943: 54).

This erroneous northern report was the only basis for the assumption (Greene, 1935: 115) that *Notropis umbratilis cyanocephalus* made use of the Lake Agassiz outlet as it reinvaded the region that was formerly glaciated.

Notropis cornutus chrysocephalus (Rafinesque)

It is extremely improbable that the central subspecies of the common shiner ranges north to Minnesota. The northern form, *N. c. frontalis,* is also western in distribution (Hubbs and Lagler, 1941: 57) and probably occupies the whole of Minnesota. Reeve M. Bailey (MS) has been unable to verify the occurrence of *chrysocephalus* in Iowa. In Wisconsin that subspecies was found only in the extreme southeastern corner (Greene, 1935: 111)—not the northeastern part of the state as written by Eddy and Surber (1943: 138). Their statements that "*chrysocephalus* and *frontalis* seem to intergrade sometimes and to be equally distributed over most of Minnesota" are almost certainly incorrect.

Notropis lutrensis lutrensis (Baird and Girard)

The red shiner is probably confined in Minnesota to the extreme southern part of the state, especially the Sioux River drainage, from which Eddy and Surber (1943: 141) reported it. The record for Cass Lake at the head of the Mississippi River (Hubbs and White, 1923: 104) was based on a small specimen of *Notropis spilopterus* (Cope).

Notropis volucellus volucellus (Cope)

It would be expected that the shiners from Garden and Oak islands, Lake of the Woods, recorded by Evermann and Goldsborough (1907: 96) and by Evermann and Latimer (1910: 130) as *Notropis blennius* (Girard), would prove referable to *N. v. volucellus,* but when re-examined at the National Museum they were found instead to be *N. a. atherinoides* Rafinesque. Two other specimens of "*Notropis blennius,*" from Rat Portage, in the same series but not listed in the published report, are *N. v. volucellus.*

Phenacobius mirabilis Girard

The record of the suckermouth minnow from the North Brule River in the Lake Superior drainage of Cook County, Minnesota (Eddy and Surber, 1943: 146), was so far out of expectation that I have regarded it as erroneous (it is a species of plains and prairie streams). Confirmation of this view has been received from Dr. Eddy, who has reidentified the immature specimens in question as *Rhinichthys atratulus meleagris. Phenacobius mirabilis* was not included in the list of the fishes of the North Shore tributaries of Lake Superior in Minnesota (Smith and Moyle, 1944: 115–124).

Ceratichthys perspicuus (Girard)

This species, formerly known as *Cliola* or *Ceratichthys vigilax* and by Hubbs and Ortenburger (1929a: 36–37; 1929b: 92–93) as *Hypargyrus velox,* has also had its range unduly extended to the northward in Minnesota. Eddy and Surber (1943: 147–148), adopting the name *Ceratichthys perspicuus* from Hubbs and Black (MS), reported that "it has been found in some of the North Shore streams of the Lake Superior drainage." Since the bullhead minnow is a species of the big, southern rivers, and is otherwise known to range northward only into southern Minnesota, this record seemed so improbable that the specimens involved were borrowed for study. There were only two examples, both from the outlet of Puck and Leman lakes, in the St. Louis River drainage, St. Louis County, Minnesota, and

both are reidentified as *Rhinichthys atratulus meleagris*. The wheel-like radii on the scales, the small barbels and other characters assure the accuracy of this determination. Smith and Moyle (1944: 115–124) did not include this species in their list of the fishes of the North Shore (Lake Superior) streams of Minnesota.

Ameiurus melas melas (Rafinesque)

The black bullhead was reported from the Lake of the Woods region by Evermann and Latimer (1910: 129), on the basis of a single young specimen from Rapid River. Suspecting an error I borrowed this specimen (No. 61508) from the National Museum and verified the identification as *Ameiurus nebulosus nebulosus* (LeSueur). It represents an extreme race in the north–south gradient that characterizes this and other species of Ameiuridae (Hubbs, 1940: 209–210). The body is very heavy, the spines small and the anal fin short. It would therefore have appeared referable to *A. melas* as that species was formerly characterized, but the strong denticulations on the pectoral spine and the rather uniformly colored fins (Hubbs and Lagler, 1941: 62) prove it to be a specimen of *A. nebulosus*. Several young bullheads from Lake of the Woods, kindly furnished by Dr. Eddy, are all referable likewise to the far–northern race of *A. n. nebulosus*. The species of *Ameiurus* have been sadly confused by most ichthyologists.

Ameiurus m. melas is common in the drainage of the Red River of the North (Hankinson, 1929: 451) and has been recorded from the Lake Superior drainage of Wisconsin (Greene, 1935: 138). "Beyond any question this bullhead is not only the most common but also the most widely distributed one in Minnesota," according to Eddy and Surber (1943: 157). These authors write that it has been collected in the St. Louis River, a Minnesota tributary to Lake Superior, and material from that river system, kindly sent to me by Dr. Eddy and Dr. Smith, represents a northern type of *A. m. melas*.

Hadropterus evides (Jordan and Copeland)

The records for the gilt darter in Minnesota were based on specimens of *Hadropterus maculatus* (Girard). The species, however, need not be deleted from the Minnesota list for it exists as an isolated population in northwestern Wisconsin, including the St. Croix River on the Minnesota border (Greene, 1935: 166, map 71).

Carlander's record (1941: 43) for the "Mississippi River at mouth of the Cannon River" was based on a specimen which I have reidentified as *H. maculatus*. Its 14 dorsal spines, coloration and other characters prove that its identification as *H. evides* was erroneous.

Eddy and Surber's records (1943: 197) also refer to *H. maculatus*. Dr. Eddy informs me that they were based on specimens identified by me in 1942 as *H. maculatus*, and that they were entered under *evides* by clerical error. The record for "small streams in Rock County" (far out of the expected geographical and ecological range of *H. evides*) was based on material from the Rock River, of the Big Sioux system, 5 miles south of Luverne, Minnesota, which had properly been reported as *H. maculatus* by Carlander (1941: 43). The record for "the Mississippi at Winona" was not checked,

unless it was based on a specimen of *H. maculatus* labelled as from the upper end of Lake Pepin. "The Cannon River" report no doubt refers to the specimen of *H. maculatus* from the Mississippi at the mouth of Cannon River.

Hadropterus evermanni Moenkhaus

The darter reported from Lake of the Woods under this name by Carlander (1941: 43–44), was examined by me in 1942. As Carlander suspected, it is a hybrid, *Imostoma shumardi* × *Percina caprodes semifasciata*. These species were taken in abundance with the hybrid, which is definitely intermediate in its characters. The tip of the premaxillaries are subvertical in side view. The least width of the fleshy interorbital is contained 5.4 times in the head. The belly is largely scaleless, and the midventral scutes are minute. The scales on the cheek are ctenoid. There are 60 scales in the lateral line. The fin formula is: D XII, 13; A II, 11. The 10 lateral blotches become vertically elongate forward and some are connected with the dorsal saddles. The black spot at the base of the caudal fin is large and round. The membranes of the spinous dorsal are dark toward the base, toward the margin and toward the front of the fin, but are pale medially. The subocular bar is a dusky roundish blotch with a weak ventral streamer. The ground color of the body is very light, contrasting sharply with the dark markings. Other characters were described by Carlander.

The Museum of Zoology collections include four series (five specimens) of the same hybrid combination, from the lower Au Sable River, just below Foote Dam, Iosco County, Michigan, where both parental species abound, and from the Wisconsin side of the St. Croix and Mississippi rivers, opposite Minnesota. The one from the St. Croix was seined near the bridge at Houlton, St. Croix County, and the one from the Mississippi was collected at Prescott, 1 mile below the mouth of the St. Croix. Both parental species were taken in the same collections.

That *Hadropterus evermanni* was based on hybrids between *Hadropterus maculatus* and *Percina caprodes semifasciata* has already been indicated (Hubbs, 1926: 60; Hubbs and Brown, 1929: 46).

Microperca microperca microperca (Jordan and Gilbert)

The record of the least darter from Lake of the Woods (Eddy and Surber, 1943: 203) calls for confirmation, for otherwise the species is known in Minnesota only from the Mississippi River system and has not been reported anywhere from the Hudson Bay drainage. There are, however, a few records for the Lake Superior tributaries in Wisconsin (Greene, 1935: 188–190, map 81) and Michigan. It therefore seems possible that this darter may have made use of some Postglacial connection to reach the Lake of the Woods. However, the Lake of the Woods record was not included in the report on Minnesota darters by Carlander (1941: 47), and Dr. Eddy now writes that neither he nor Dr. Carlander can find any Lake of the Woods records or specimens of this species.

Lepomis megalotis peltastes Cope

Confirmation is needed for the reports of the occurrence of *Lepomis megalotis* in Minnesota and northeastern Iowa (Woolman, 1896: 352, 358; Cox, 1896; 610—an obvious misstatement; 1897: 58; Surber, 1920: 51—

figure copied; Green, 1935: 198; Hubbs and Lagler, 1941: 79; Eddy and Surber, 1943: 216–217, fig. 45). The figure given by Eddy and Surber was obviously not based on *Lepomis megalotis*. It appears to represent one of the rare hybrid combinations, *Lepomis humilis* × *Lepomis macrochirus macrochirus*. Dr. Eddy writes that the specimen, unfortunately, was dried out and discarded when the photograph was made, but he has sent for examination two other specimens which he believes were included in the same collection. These prove to be old males of *Lepomis humilis*. It may be pertinent that the Minnesota records for *L. megalotis* were made by authors (Woolman, Cox, and Surber) who did not recognize *Lepomis humilis* in the state. Even if some of the old records should prove to have been based on *Lepomis megalotis*, the subspecies identification would remain to be determined. Woolman's specimens cannot be located in the National Museum, I am informed by Dr. Leonard P. Schultz.

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The Symplectic in Coelacanthids and Actinopteri

By THEODORE H. EATON, JR.

THE symplectic is a bone or cartilage present in most fishes just behind the palatoquadrate series of the upper jaw, and connecting this with the anterior face of the hyomandibular. Nearly always the symplectic lies between the hyomandibular and the quadrate, thus aiding in a firm suspension of the latter, and through it supporting both upper and lower jaws. Thus, whenever it is present at all, the symplectic is associated with hyostylic jaw suspension. There is a tendency for it to develop most strongly in those fishes, like sturgeons, that have little other skeletal support for the jaws, or in many teleosts where, secondarily, the hyomandibular lies at considerable distance from the jaw articulation.

On the other hand, there are many fishes with hyostylic jaws in which there is no symplectic. Of course there is none in sharks, for the hyomandibular lies immediately behind the palatoquadrate and attaches to it by a short ligament, approximately at the joint between upper and lower jaws. *Polypierus*, a very primitive actinopteran, has no symplectic, nor is there any indication of its presence during early development (DeBeer,

1937). DeBeer and others, on the assumption that it must have fused with the hyomandibular, use the name hyosymplectic for the latter element, but I am inclined to doubt that a symplectic occurred in the ancestry of *Polypterus*. A bone which was probably the symplectic has been figured in the Permian *Dorypterus*, a fish highly specialized in its jaw mechanism (Westoll, 1941). There is no evidence of a symplectic in any Dipnoi, but these are autostylic, having the upper jaw fused with the cranium and the hyomandibular degenerate, doubtless secondarily. It is apparently absent also in the hyostylic crossopterygian suborder Rhipidistia, a more primitive

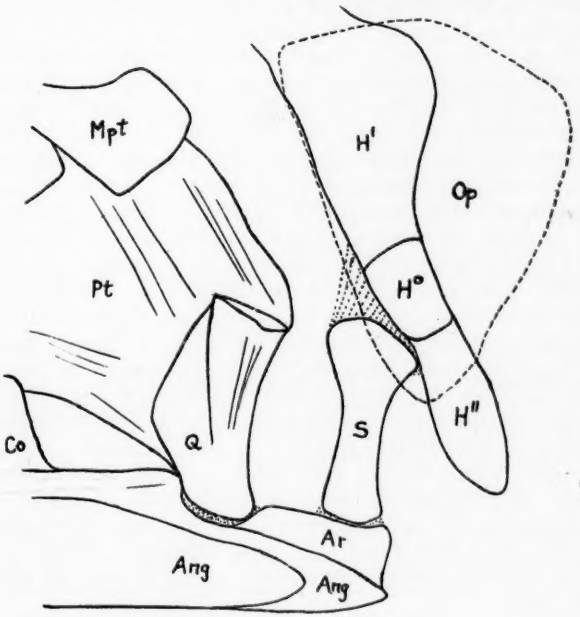

Fig. 1. Inner cheek bones and jaw articulation in *Latimeria* (after Smith, 1939).
Ang, angular; Ar, articular; Co, coronoid; H', H'', dorsal and ventral cartilaginous portions of hyomandibular; H°, ossified portion of hyomandibular; Mpt, metapterygoid; Op, opercular; Pt, pterygoid; Q, quadrate; S, symplectic.

group than the suborder Coelacanthini. In an account of the hyomandibular and stapes the writer tentatively restored a ligamentous connection between the hyomandibular and the palatoquadrate of *Megalichthys* (*Ectosteorhachis?*) (Eaton, 1939). Actual evidence for the nature of this connection is not yet available (Romer, 1941). Further interpretation of the rhipidistian hyomandibular is given by Westoll (1943b).

The occasion for the present note is the peculiar symplectic found in *Latimeria*, the living Coelacanth of South Africa (Smith, 1939). Not only is there no connection with the quadrate (the palatoquadrate series contains

separate bones here, which it apparently does not in *Megalichthys*), but the symplectic has its own, more posterior, articulation with the lower jaw (Fig. 1). Between the symplectic and the ossified part of the hyomandibular Smith describes a firm cartilaginous junction. It may be that in life some flexibility existed here, but in any case the symplectic would seem to transmit movement, during depression of the mandible, from the articular to the hyomandibular and thence perhaps to the operculum and the lower parts of the hyoid arch.

In some other coelacanths (*Diplocercides*, Stensiö, 1937) the articular bore a posterior facet similar to that of *Latimeria;* Smith infers that a symplectic of this type occurred in the whole family. Westoll (1939), in his redescription of the Permian Coelacanth *Spermatodus pustulosus*, calls attention to a double facet (anterior and posterior) on the articular, which is held to match the condyles on the quadrate; but it seems, from his figures and from this discussion, that perhaps a symplectic met the posterior facet. Mechanically, too, this appears more plausible than that a single bone, the quadrate, should have relations with two facets, one behind the other, on the mandible, when the movement of the latter is simply hinge-like.

That hyostylic jaw suspension originated in fishes when the hyoid arch adopted a supporting relationship with the palatomandibular arch is evident enough. This took place some time after the latter arch had formed jaws, although it had not yet done so in the acanthodians (Watson, 1937). Most probably such a connection at first had the form of a ligament in the connective tissue that newly filled the former gap between the two arches. From this I would suggest that the symplectic, which we have seen is more obvious in specialized than in primitive lines, probably originated more than once, and so is not strictly homologous in such divergent groups as coelacanths and Actinopteri. It may be called homoplastic rather than homologous. When ossified, it appears in the embryo as a separate center in a cartilaginous process extending forward or down from the hyomandibular, and unmistakably a part of this (e.g., *Amia, Lepisosteus, Salmo*); from the end of such a process comes the ligamentous or direct connection with upper (or lower) jaw.

There is no reason, of course, to suggest a new name for the piece found in coelacanths. The recent evidence that the frontals, parietals, nasals, and other roofing bones of Actinopteri are not homologous with those so named in tetrapods (Westoll, 1943a) is not an occasion for overthrowing the well-established usage in either fish or tetrapod osteology, but such cases show that homoplasia, as distinguished from strict homology, is more frequent than has been supposed.

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Water Absorption in a Terrestrial Salamander

By ROBERT C. STEBBINS

WHILE engaged in ecological studies on the brown salamander, *Ensatina eschscholtzii eschscholtzii* Gray, in southern California, some data on dermal water absorption were procured. Such water absorption through the skin is in general characteristic of amphibians, but it has not often been measured.

An adult male brown salamander was found in a tunnel beneath the dome-shaped, stick-pile nest of a wood rat (*Neotoma*) in a shady canyon in the Santa Monica Mountains. It was obtained through dismemberment of the nest in an attempt to locate individuals of this species, which had been common beneath surface litter prior to the summer and fall dry period. At the time of the discovery of this specimen, October 21, 1944, none had been seen since the middle of July. In most places, even in the shadier portions of the habitat, the soil was dry to a depth of about 6 inches, crumbling in the fingers to a fine powder.

The site of summer retreat was at a depth of 3 feet. The moisture content of the soil at this level was 15 per cent as determined by the weight lost from a sample dehydrated in an oven at 110 degrees C. The temperature of the earth at the collection site was 16 degrees C.

In view of the extreme dehydration of the excavated animal, it was considered a good subject for experiment on integumentary water absorption in this species.

When brought into the laboratory, the salamander weighed 3.68 gms. (Fig. 1). It was placed in a pint jar with several moist paper towels in the bottom. A loose fitting lid covered the container. A second weighing was

made after 20 hours. At this time it weighed 5.11 gms. (Fig. 2), a gain of 1.43 gms. The animal's skin had become turgid with fluid. It appeared smooth and taut. Throughout subsequent weighings there was no appreciable gain in weight. From these data, it is apparent that the animal had absorbed water equivalent to nearly 40 per cent of its total original weight. Judging from its appearance shortly after placing it in the moist chamber, I feel confident that most of this water was absorbed during the first few hours. Prior to each determination, the animal was dried in a compressed air stream to remove water clinging to the surface of the skin.

It is assumed that absorption took place through the integument since the damp paper towels did not provide water available for drinking. Furthermore, it is doubtful if this animal ever drinks, in the sense of swallowing free water. Terrarium specimens under close observation have not been observed to take water though they have had ample opportunity to do so.

In consideration of the preceding marked increase in volume and weight of the experimental animal, it is not surprising to find that the first salamanders that reach the surface in the fall, following the first rains, look plump and "well fed." These first comers appear in excellent condition even though they have been subjected to several months of rainless weather and probably also to a reduction in food intake. Three emaciated excavated animals had empty digestive tracts.

The first rain that broke the dry spell in the Santa Monica Mountains in 1944 came on October 20. Water penetrated the soil for only about ½ inch, but on November 5 a storm wetted the soil to a depth of about 1½ to 2 inches throughout most of the region of study. This rain was followed by the appearance of salamanders on the surface. One *Ensatina*, 30 *Batrachoseps attenuatus attenuatus* and a single juvenile *Aneides lugubris* were collected on this day. None of these amphibians showed any external evidence of desiccation although they had been subjected to several months of rainless weather.

Frequent digging in the surface to a depth of 6 to 8 inches throughout the habitat during the summer period had revealed no salamanders. This superficial material was obviously too dry, even in the shadier places, to harbour the animals. It was surprising to discover such a large number of them on the surface following a rain that moistened the soil to such a shallow depth.

Apparently it is not essential that the water content of the soil surrounding the subsurface animals be increased in order that they be stimulated to move toward the surface. It is probable that the presence of surface moisture is sensed through changes in the water content of the air permeating the subterranean niches occupied by the animals. It is possible that the capture of the salamander herein discussed resulted from such a response to air humidity. In following the burrows of the pack rat nest mentioned earlier, a large hole was dug. Due to the depth to which the main gallery was descending, the task was at last abandoned. In climbing out, some earth fell into the hole, covering the opening of one of the tunnels. A very light rain fell that night, moistening the surface of the soil to a depth of about ½ inch. The next day in poking into the crumbled shaley soil in the bottom of the

pit, the salamander was discovered. It may have been attracted by the presence of moisture to the mouth of the burrow, where it had encountered the earth obstruction. When found, it was covered with adhering fragments of soil and was buried in this loose material.

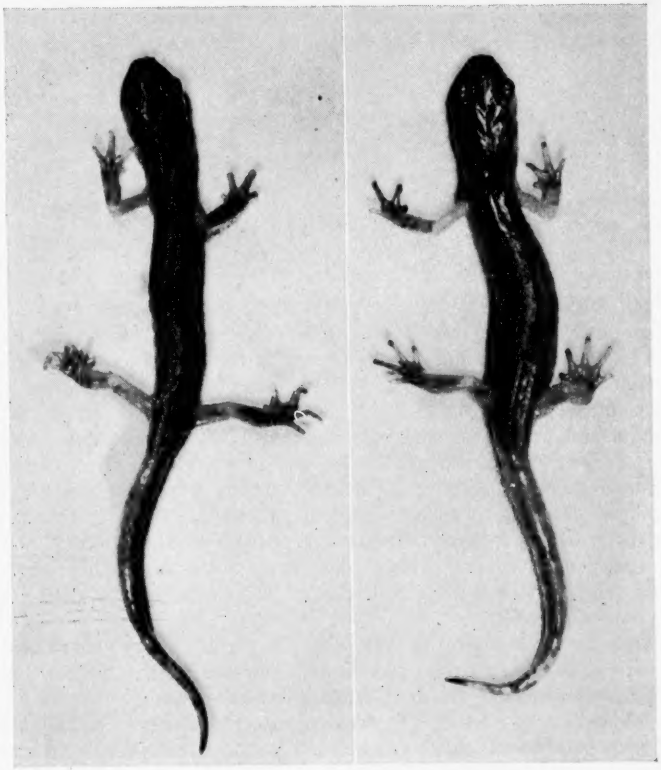

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Fig. 1. An adult brown salamander (*Ensatina eschscholtzii*) as it appeared upon removal from a rodent burrow. It weighed 3.68 gms.

Fig. 2. The same animal after being placed on damp paper towels for 20 hours. It weighed 5.11 gms., an increase of 1.43 gms. or 40 per cent of the total original weight.

The Santa Monica Mountains are near the southernmost part of the known range of *E. eschscholtzii*. The existence of this species in a relatively dry climate (for salamanders) is made possible by its selection of the deeper, shady canyons, which for the most part extend north-south, in which direct illumination occurs for only a few hours each day. Vegetation is well developed in these canyons, particularly at the most critical time for the humidity factor, which is during the summer. During these months the wild black walnut (*Juglans californica*) is fully leafed. This leafy canopy further dimin-

ishes the daily illumination and evaporation. In addition, summer coastal fogs, which are almost a daily occurrence, bathe what would otherwise be a dry region and at the same time reduce insolation. During the rainless period the animals resort to a more completely subterranean existence at depths where the relative humidity is more nearly optimum.

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The Habits of the Rainbow Snake in Virginia

By Neil D. Richmond

THE following observations on the rainbow snake, *Abastor erythrogrammus* Latreille, were made over a period of six years at Shackelford Farms, near Lanexa, New Kent County, Virginia. In this area *Abastor* is unusually abundant in dry, sandy fields, and affords numerous opportunities for study. Shackelford Farms is situated on the Chickahominy River, which, at this point, is fresh water (becoming only slightly brackish in periods of prolonged drought), with a normal tidal variation of 2 to 3 feet. The river is bordered with large tidal marshes, varying in size from one to several hundred acres. The lowest coastal plain terrace (Pamlico), adjacent to the river and marshes and about 10 feet higher in elevation, is covered with light, sandy soil for the most part. The open fields of this terrace are separated from the river and marshes by narrow strips of thicket or pine woods, generally less than a hundred feet in width.

The habitat of *Abastor* in New Kent County is the dry, sandy fields of the lower coastal plain terrace and the adjoining marshes and bodies of water. In the sandy fields it is the most abundant snake, as many as twenty having been plowed out of a ten-acre field in one day, and it is so commonly associated with this type of situation that it is known locally as the "sand snake." Although one of the most abundant snakes in the county, its burrowing habits make it less conspicuous than such forms as *Natrix* and *Elaphe*. While more often seen on land, it is equally at home in the marshes and open water. One adult was observed crawling on the bottom of a marsh creek, in water about 2 feet deep, finally disappearing down a hole in the bottom of the stream. Another, a small juvenile, was seen burrowing in the thin mud at the edge of the marsh, in water about a foot deep. Several have been seen swimming in the shallow water of the river and ponds. Most of the specimens, however, have been observed on land, either crawling on the surface or unearthed by plowing or cultivation. During late fall (October and November) and early spring (April and May), young specimens have been found under boards, logs, tar-paper and other objects lying on the surface of the ground. The largest numbers of all sizes, however, were turned up by the plow in late March and April.

The rainbow snake apparently has no definite period of hibernation, since active specimens have been recorded in every month of the year. Even during the colder months they venture above ground, for a hawk was observed eating one on the ice of the marsh in February.

When approached in the field, *Abastor* makes no attempt to escape; in fact, unless actually handled, it completely ignores an observer, and continues in whatever activity it may be engaged. This is illustrated by the following excerpt from my field notes, of June 24, 1939:

> While watching a *Kinosternon* I saw a large *Abastor* come up over the bank, going away from the marsh, crossing the narrow strip of woods and thicket toward the open field. It was just gliding along, apparently not hunting, since its rate of speed was constant and it was traveling in an almost straight line. I walked over to it and was surprised to find that it ignored me completely, even when I walked along beside it. Thinking that perhaps it was unaware of my presence I crossed directly in front of it, but it merely paused long enough to let me pass, and then continued at its same steady rate, without even raising its head.

Whether crawling or swimming, specimens move in a slow, steady fashion. Even when released, after being handled, they still crawl off with the same unhurried gait. It is apparent, however, that they are capable of rapid movements, for when they are first caught the posterior half of the body thrashes around violently and the sharp caudal spine is used to scratch or prick the collector—a maneuver which is more startling than effective, since the spine will not pierce the skin. At the same time, the forepart of the body probes around in the leaves or ground trying to find a hole, or a place soft enough to burrow. Of all the specimens handled, none has ever attempted to bite.

On two occasions feeding has been observed in the field. Each time the snake was eating an eel (*Anguilla*). A third snake was reported eating a "large brown eel" in the pond. This "eel" may have been an *Amphiuma*, for *Anguilla* and *Amphiuma* are both fairly common in the pond. One of the snakes observed took the eel out of the water onto the shore to swallow it. The other was seen swimming in the river with an eel in its mouth, and was removed from the water with a net and placed on the lawn, where it continued to swallow its catch as though it had not been disturbed. Each of the snakes observed feeding was about 30 inches long, and each had a small eel, about 8 to 10 inches in length. Both eels were caught about midway of the body, then maneuvered until they could be swallowed head first. Captive specimens of various sizes have not eaten, although they have been offered frogs, toads, earthworms, and small mice. Several specimens were dissected, in an effort to learn more of their food habits, but their stomachs were empty, except for one that contained a few fragments of a very white muscle tissue. On gross examination, this white muscle tissue appeared to be of either fish or amphibian origin. The absence of recognizable remains in the intestines would seem to indicate that they do not feed on insects or warm-blooded animals to any extent.

Three times hawks have been seen feeding on *Abastor*, and several times partially eaten remains have been found around the fields and marshes. In September, after the eggs have hatched, nests have been found that had been opened by unknown predators, although some hatchlings remained in them. Whether any of the hatchlings had been eaten could not be deter-

mined, since most of the young were scattered through the soil surrounding the nest. In July, 1944, five nests were found that had been opened by skunks; of these, only two were completely destroyed, the other three containing four, sixteen and twelve eggs respectively.

This snake is also subject to a number of parasites. Dead specimens, without external mutilation, are frequently found. Whether this indicates that *Abastor* is more susceptible to disease than other species in the vicinity, a difference in behavior that makes *Abastor* seek more open places when dying, or merely reflects the density of the population, is not known. In this connection it is interesting to note that, including those killed by predators, more specimens of *Abastor* have been found dead than specimens of all the other local snakes combined. Dissection of two of those found dead revealed a heavy infestation by two types of nematodes. One small form, 3-5 mm. long, was present in all of the mesenteries and in the connective tissue around the esophagus and trachea. The other, a large form, 50 mm. long, was coiled in the wall of the stomach and extended, through an ulcer, into the lumen of that organ. In each specimen the ulcers almost covered the wall of the stomach. Whether or not these had caused death could not be determined. *Abastor* may also be heavily infected with a large nematode of the family Dracunculidae. This worm, living in the subcutaneous connective tissue, produces a lesion through which its larvae are discharged. In cases of heavy infestation the snakes appear to be almost covered with small sores. Non-feeding, captive specimens are most conspicuous in this respect, although similarly affected individuals have been seen in the field. One specimen was found that had a large, maggot-infested ulcer, but it was not determined whether the maggots were larvae of the common blow fly, or of the screw worm fly. Many specimens are infested with mites, although no other ecto-parasites have been observed.

All of the nests observed have been in an open, exposed, dry, sandy field, and in the same portion of the field as that chosen by *Kinosternon*, *Chrysemys*, and *Pseudemys* for their nests. The eggs are deposited in a large, oval cavity, 4 to 6 inches below the surface of the ground. One nest, 4 inches below the surface, was measured, and it was found that the cavity was 4 inches from top to bottom, 8 inches long and 6 inches wide. When found, this nest contained 33 egg shells, three hatchlings and a number of shed skins. Spring plowing, in April and early May, has failed to reveal any nests. The only obviously gravid female collected was obtained on June 24, 1939. On dissection this specimen was found to contain 20 eggs, the shells of which were very thin and soft, apparently not quite ready to be laid. On July 15, 1944, a female was found in the act of laying eggs, and on the same day two other nests were found with eggs which contained embryos 60 mm. long. Laying, therefore, probably starts about the first week in July. Hatching probably takes place in early September, for opened nests with hatchlings have been found on September 18 and 23. The hatchlings shed before leaving the nest. Characteristically, the nest in late September contains egg shells, a tangled mass of shed skins, and a few hatchlings; the remainder of the hatchlings are scattered through the near-by soil.

SHACKELFORD FARMS, LANEXA, VIRGINIA.

The Status of *Hyla phaeocrypta* with Notes on its Variation

By M. B. Mittleman

NOT long ago I had occasion to examine the tree frog currently referred to *Hyla avivoca* Viosca, and was struck by the marked similarity between this species and *Hyla versicolor* LeConte. Wright and Wright (1933: 109) consider these frogs to be distinct species, whereas Burt (1938: 344) does not find the diagnosis very convincing, conceding only the difference in voice in *avivoca*. The Wrights give a few ratios tending to separate *avivoca* and *versicolor*, and make mention of certain characteristics of color, which, unfortunately, are difficult to discern in many preserved specimens. I now believe that the earlier name, *Hyla phaeocrypta* Cope, must be applied to the species described by Viosca.

Thinking that biometric analysis might yield a more concrete definition of the species, I endeavored to borrow as much of the preserved *avivoca* material as possible, and also to obtain a few living examples. In all, not including type material, I had available 101 preserved *avivoca*, and four living specimens, which were ultimately preserved. For comparative purposes I had 66 *versicolor*, chiefly from the Mississippi Valley states wherein *avivoca* is known to occur. From each of these specimens eleven measurements of limbs and other structures were taken, and in turn from these data thirteen ratios were computed. With these data, plus certain other information, it was found possible to diagnose and limit *avivoca* definitively. The status of *Hyla versicolor phaeocrypta* Cope relative to *avivoca* and *versicolor* afforded the next problem. Mr. Karl P. Schmidt suggested that the problem of the status of *phaeocrypta* might be solved by biometric comparisons of the type with my data. The type of *phaeocrypta* was accordingly studied in detail for this purpose.

Cope's description of *phaeocrypta* was based on a single preserved frog (USNM 12074), collected by Lucien M. Turner at Mt. Carmel, Wabash County, Illinois. His comments (1889: 375) are brief, and beyond some references to color and pattern, and the statement that in its integument and feet it is of the *versicolor* kind, not very much can be derived from the description. Other than to state that in its dimensions it bears a general resemblance to *Hyla femoralis*, Cope offers no mensural data on his new form. He named it *Hyla versicolor phaeocrypta*. Various writers from time to time either listed the name provisionally, or used it in a nominal sense for various superficial varieties of *versicolor*.

As Viosca reported in 1928, the type of *phaeocrypta* is not well preserved as to color, and is somewhat soft. It is in much better condition than many of Cope's types, however, and despite fading it still shows some traces of pattern and may be measured with accuracy. Viosca (*op. cit.*) considered the type of *phaeocrypta* to be a "fairly typical specimen of *Hyla versicolor* . . . well within the range of individual variations normally exhibited by that species." It is, despite its imperfect preservation, manifestly a smooth-skinned frog. Probably at no time did it ever bear the warts and rugosites so characteristic of *versicolor*, even allowing for the exigencies of indifferent preserva-

tion. If it is compared with specimens of *versicolor* that have been preserved for an equal length of time, these latter, while smoother in general appearance than freshly preserved material, still have a characteristically pustulose and papillar dorsal surface. Secondly, the type is a male, and although the viscera are somewhat displaced because the stomach is crammed almost to the bursting-point with insects, the gonads can be observed to be large and well developed. Without doubt, the type represents an adult male frog, taken during or near the breeding season. This fact, coupled with a snout-anus measurement of 30.7 mm., eliminates the animal from the *versicolor* category; the latter form is not sexually mature in the male until a length of about 40 mm. or slightly more is attained, as I gather from material I have examined.

The *phaeocrypta* type has, as Cope pointed out (*loc. cit.*), the subocular light spot and general form and structure associated with *versicolor*. By elimination, Cope's frog can only be *versicolor* or the species subsequently described as *avivoca*. The subocular light spot is common to both forms. In the type of *phaeocrypta* definitive color is lacking, the specimen being of a fairly uniform light brown, save for some barely discernible pattern on the dorsum and limbs. It is necessary to examine the specimen biometrically, and compare the data obtained with the norms and variations known for series of the two species to determine its identity.

In the following tables, digests of the mensural and proportional data of 91 sexually mature male *"avivoca"* and 50 sexually mature male *versicolor* are given. The former are largely from the type locality (Mandeville, Louisiana) of *avivoca* and immediately adjacent areas, although specimens representing nearly every known general locality where the species occurs have been included. The *versicolor* series is a homogeneous sample of 40 specimens taken from a single chorus at Indianapolis; the remaining specimens have come from the Mississippi Valley in Illinois, Kentucky, Missouri and Tennessee.

It is immediately obvious from these data that the types of Cope's *phaeocrypta* and Viosca's *avivoca* (which is also a sexually mature male) are very similar, and both fall easily within the variational limits found for the *avivoca* series. In all discrete data, the *avivoca* form is manifestly a smaller animal than *versicolor*. Proportionately, it is characterized by a longer hind limb, greater interocular and internasal spaces, a smaller tympanum, and a larger eye. Certain other trends seem indicated, but my data are not extensive enough to confirm them. Unfortunately, while these mensural and proportional data are useful for defining populations, the overlap in most instances is so great as to strongly restrict their usefulness in the identification of individual specimens save where the standard deviations and d/σ (in connection with the areas and ordinates of the normal curve) are employed as well. An exception to this is the ratio of the diameter of the tympanum to the diameter of the eye, in which no overlap appears. Tympanic measurements are taken across the greatest diameter of this organ on the rim of the tiny ridge it bears, while the diameter of the eye is measured horizontally from the angles formed by the lids; measurements were taken with a vernier-scale caliper under low magnification, and such accuracy is essential.

TABLE I

	avivoca			*versicolor*			type *phaeocrypta*	type *avivoca*
snout-anus length	29.0–	*33.9* (2.2)	–40.0	40.0–	*44.8* (2.4)	–50.0	30.7	32.0
head length	9.0–	*10.7* (.74)	–13.0	12.0–	*13.5* (.76)	–15.0	9.1	9.2
head width	11.0–	*12.5* (.79)	–14.0	14.0–	*16.3* (1.0)	–18.5	11.2	12.0
intertympanic width	9.0–	*10.5* (.62)	–12.0	12.0–	*13.3* (.73)	–15.5	9.0	9.5
diameter eye	3.0–	*3.8* (.29)	–4.5	4.0–	*4.1* (.26)	–5.0	3.7	4.0
diameter tympanum	1.25–	*1.60* (.16)	–2.00	2.0–	*2.5* (.25)	–3.0	1.5	1.6
internasal space	2.5–	*2.9* (.28)	–3.5	2.7–	*3.4* (.31)	–4.0	2.6	3.0
interocular space	3.0–	*3.5* (.37)	–4.5	3.5–	*4.0* (.33)	–5.0	3.0	3.2
hind limb length	43.0–	*51.0* (3.7)	–61.0	55.0–	*62.0* (3.5)	–70.0	46.0	49.0
4th toe length	12.0–	*15.1* (1.5)	–18.0	17.5–	*19.8* (1.2)	–23.0	14.0	15.5
3rd finger length	8.0–	*10.4* (.89)	–12.5	12.0–	*14.3* (.85)	–16.0	10.0	10.0

Measurements of 91 sexually mature male *Hyla avivoca*, 50 sexually mature male *Hyla v. versicolor*, the type of *Hyla versicolor phaeocrypta*, and the type of *Hyla avivoca*. Italicized figures are means, parenthetical figures are the standard deviations.

TABLE II

	avivoca			*versicolor*			type *phaeocrypta*	type *avivoca*
snout-anus/hind limb minus 4th toe	86.0–	*97.0* (6.54)	–120.0	94.0–	*107.0* (5.46)	–120.0	96.0	96.0
4th toe/snout-anus	39.0–	*44.0* (2.21)	–50.0	41.0–	*44.0* (1.83)	–48.0	45.5	48.5
4th toe/hind limb	25.0–	*31.0* (1.57)	–33.0	28.0–	*32.0* (1.27)	–35.0	30.4	31.6
snout-anus/hind limb	62.0–	*68.0* (2.84)	–74.0	66.0–	*71.7* (3.00)	–78.0	66.7	65.2
tympanum/eye	33.0–	*43.0* (2.90)	–47.5	50.0–	*60.0* (5.80)	–71.0	40.0	40.0
interocular/snout-anus	8.0–	*10.3* (.94)	–13.3	7.7–	*8.9* (.70)	–10.7	9.7	10.1
internasal/snout-anus	7.1–	*8.5* (.75)	–10.0	6.4–	*7.9* (.58)	–8.9	8.4	9.3
tympanum/snout-anus	3.7–	*4.7* (.41)	–5.7	4.7–	*5.6* (.44)	–6.6	4.8	5.0
eye/snout-anus	9.3–	*11.1* (.72)	–12.7	8.0–	*9.3* (.68)	–11.3	12.0	12.5
head length/snout-anus	26.7–	*31.8* (1.73)	–35.0	28.1–	*30.1* (1.09)	–32.6	29.6	28.7
head width/snout-anus	29.4–	*36.3* (1.83)	–39.4	30.5–	*35.7* (1.67)	–39.1	36.5	37.5
head length/head width	74.0–	*87.5* (4.02)	–96.0	78.5–	*84.7* (3.68)	–96.5	81.2	76.5
head length/intertympanic	91.2–	*102.9* (4.06)	–115.0	93.5–	*101.5* (3.06)	–108.2	101.0	96.8

Proportions of 91 sexually mature male *Hyla avivoca*, 50 sexually mature male *Hyla v. versicolor*, the type of *Hyla v. phaeocrypta*, and the type of *Hyla avivoca*. Italicized figures are means, parenthetical figures are standard deviations.

The pattern of the type of *phaeocrypta* is in no way unique, and is duplicated by many of the Louisiana specimens; mensurally and proportionately the *phaeocrypta* type is in accord with the known variations of undoubted *avivoca;* it seems clear then, that Cope's *phaeocrypta* and Viosca's *avivoca* represent the same species, which must be known as *Hyla phaeocrypta* Cope.

Hyla phaeocrypta occurs from southern Illinois (Jackson, Richland, Alexander, and Wabash counties) through the Mississippi Valley to Louisiana (excluding the swamps of the valley and the coastal plain lying to the west), thence east to Florida (Jackson, Liberty counties) and north to Georgia. In addition, I have heard the call of this species in the gum trees of the mud flats along the Wabash River on the outskirts of Terre Haute, Indiana. Harper (1933: 230) tentatively includes Burt's record (1928: 630) of *Hyla phaerocrypta* [*sic*] from Riley County, Kansas, within the range of the species; I am inclined to disregard it as a record for this form, and consider the specimen as probably referable to *versicolor.*

Of specimens extant, I have seen but three females of *phaeocrypta,* representing 2.85% of the total number studied. Carr (1940: 58), reporting on Floridian specimens, says that he has never seen a female. Females of this species must be highly secretive or else there is a significant deviation from the general sex ratio of most animal populations, for collections have been made throughout the spring and summer months when they would presumably be abroad.

Harper (*loc. cit.*), in reporting the occurrence of *avivoca* (= *phaeocrypta*) in the Ogeechee River swamp, near Louisville, Jefferson Co., Georgia, includes in his data notes on a female specimen with a snout-anus length of 49 mm., supposedly of this species. I have had only a few specimens from peripheral points in the range of *phaeocrypta* available to me; these in no discernible way differed from other material. Comparing Harper's measurement with the *avivoca* (*phaeocrypta*) snout-anus data shows that *P* equals considerably less than 0.006 ($d/\sigma = 5+$), or, that the chances of a specimen of these proportions occurring in the populations sampled are less than .06 times in 1000. In practice, these chances are about nil. Conversely, comparison with the *versicolor* data shows that *P* equals 16 ($d/\sigma = 1.4+$), or that the chances of such a specimen occurring in the *versicolor* populations are about 16 in 100, and in practice, quite good. These considerations are admittedly theoretical; if Harper's specimen is truly referable to *phaeocrypta* it probably indicates a significant size trend in Atlantic coastal populations. It seems much more likely that it is simply a *versicolor.*

Complete series of *phaeocrypta* from the larval and early post-larval stages through the subsequent years to fullest maturity are not now available; indeed, much of the life history and ecology of this animal are chiefly surmisal from fragmentary data at hand. Available specimens indicate that 29 mm. is the lower limit of size of sexually mature males; an extreme limit of 41 mm. is known for males, and 42 or 43 mm. for females. Neither the eggs nor the tadpoles have been described; quite possibly they may reflect some affinity with *versicolor,* as Wright has found to be true in the case of *Hyla femoralis* (1932: 285, 289).

Wright and Wright (1933: 229) suggest that the bird-voiced hyla breeds

from June to mid-August. Available evidence indicates an earlier season. Harper (*loc. cit.*) reports clasping on April 25, near Louisville, Georgia; Carr (*loc. cit.*) says that breeding in Florida has been observed from April 11 to July 12; Cagle (1942: 180) has found the species abroad in southern Illinois as early as March; Endsley (1937: 70, and private communication) has taken males and females together in early May in Chester County, Tennessee; I have heard the species calling in mid-April near Terre Haute, Indiana. Finally, I have examined two females taken by Viosca on April 11 (St. Tammany Parish, La.), one of which is spent, the other with the oviducts packed with ripe ova. A third female, taken in St. Tammany Parish, but on June 12, is also gravid and greatly distended with ova. These data point to a breeding season extending from early April to the middle of July, depending on local conditions.

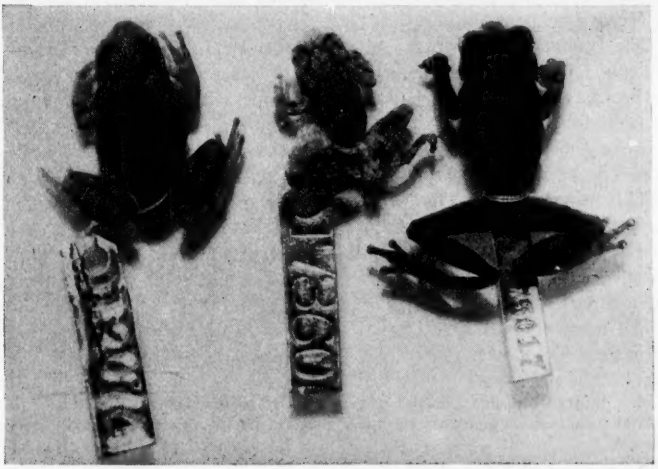

Fig. 1. Left to right, type, *Hyla phaeocrypta*, USNM 12074, Mt. Carmel, Wabash Co., Ill., actual length snout to anus, 30.7 mm; juvenile *Hyla v. versicolor*, USNM 17360, Great Falls of the Potomac, Montgomery Co., Md., actual length snout to anus, 22 mm; type, *Hyla avivoca*, USNM 75017, Mandeville, St. Tammany Parish, La., actual length snout to anus, 32 mm.

The highly distinctive voice of *phaeocrypta* need be confused with no other North American hylid save possibly *Hyla crucifer*. It does not take a particularly keen ear to distinguish the voices of these two species. The call of *phaeocrypta* is lower-pitched, and is usually composed of a short trill, followed by several piping, or whistling notes. The call of *crucifer* usually consists of a number of whistles, all of about equal length. The difference between these calls can be shown thus: —..... (*phaeocrypta*); — — — — — — — — — — (*crucifer*). The similar-appearing *versicolor* has a call quite unlike that of *phaeocrypta*, for it is a coarse, toad-like trill, relatively low-pitched. The call of *Hyla femoralis*, which in appearance at least, is similar to *phaeocrypta*, is a coarse, grating, staccato

croaking repeated in rapid succession several times a minute, described by Harper (in Wright, 1932: 278) as *kek-kek*, and ending with a *krak-krak*.

The texture of the skin is difficult to describe but *phaeocrypta* is a much smoother-appearing animal than *versicolor*. Where the latter is dorsally warty or pebbled, the former is but finely granular, or in preserved material quite smooth. The smallest *versicolor* is usually much coarser-skinned than the largest *phaeocrypta* (see cut).

There is little difference in the color and pattern of *phaeocrypta* and *versicolor*. The markings are possibly slightly less massive dorsally and tend to be somewhat more posteriorly situated in the former. In living and freshly preserved specimens of *phaeocrypta* the most outstanding point of difference is the bright green color of the axillary and inguinal areas and the postfemoral surfaces. In *versicolor*, this hue is replaced by a golden or orange wash. Unfortunately, these pigments seem quite soluble and are not discernible in most preserved specimens.

The ecological differences between *phaeocrypta* and *versicolor* are not understood. While the mechanical barrier of size probably aids in preventing interbreeding, other factors must surely be operative. Wherever *phaeocrypta* has been taken, *versicolor* has also been found. They apparently breed at the same time, in the same waters, and share the same general ecological niche. The barriers that separate these sympatric forms are, by elimination, probably physiological. The two species are remarkably similar, yet surely genetically distinct. A field study of the relationships of *phaeocrypta* and *versicolor*, of *versicolor* and *femoralis*, and where they occur in the same general region, of *femoralis* and *phaeocrypta*, might solve some of the problems involved.

The more obvious characteristics of *phaeocrypta* and *versicolor* may be summarized as follows:

phaeocrypta

1. Call a piping, bird-like whistle.
2. Dorsal skin finely granular, or quite smooth.
3. Inguinal and postfemoral areas with a bright green wash.
4. Minimum male breeding size 29 mm., maximum size 41 (♂) or 43 (♀) mm.
5. Hind limb proportionately longer: ratio snout-anus/hind limb averages 68% (range 62.0–74.0%).
6. Interocular space proportionately greater: ratio interocular/snout-anus averages 11.4% (range 8.0–13.3%).
7. Internasal space proportionately greater: ratio internasal/snout-anus averages 8.5% (range 7.1–10.0%).
8. Tympanum proportionately smaller, eye proportionately larger: ratio of tympanum/eye averages 43.0% (range 33.0–47.5%).

versicolor

1. Call a toad-like trill.
2. Dorsal skin warty or heavily pustulose.
3. Inguinal and postfemoral areas suffused with orange or golden.
4. Minimum male breeding size 40 mm., maximum size 51 (♂) to 60 (♀) mm.
5. Hind limb proportionately shorter: ratio snout-anus/hind limb averages 74% (range 66.0–78.0%).
6. Interocular space proportionately smaller: ratio interocular/snout-anus averages 8.9% (range 7.7–10.7%).
7. Internasal space proportionately smaller: ratio internasal/snout-anus averages 7.9% (range 6.4–8.9%).
8. Tympanum proportionately larger, eye proportionately smaller: ratio of tympanum/eye averages 60% (range 50.0–71.0%).

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Water Goggling: A New Method for the Study of Turtles [1]

By LEWIS J. MARCHAND

THE large, crystal-clear, spring runs of Florida hold great promise for the student of natural history. These interesting streams, clear to depths up to a hundred feet and more, with an abundant fauna and flora, and constant year-round temperature, offer almost unparalled opportunities for the study of the life-histories of many animals. In my own studies of turtles I have long felt that the natural history resources of these streams warranted a search for something better than the routine methods of trapping, seining, and the use of baited lines.

Water goggles were first extensively introduced upon the market in 1936, and were at this time of the two eyepiece type. These were not entirely satisfactory, since the diverging eyepieces do not permit the focussing of both

1 A contribution from the Department of Biology, University of Florida.

eyes on a single object simultaneously. Furthermore, the area of glass is so small that if any fogging occurs the goggles must be taken off and cleaned. More recently a new type of goggle has been introduced. A large hard rubber frame holding a single circular piece of glass was shaped to fit the face and to enclose the nose and eyes. This type of goggle has certain advantages. Normal binocular vision is possible and, since the area of glass is so much larger, the field of vision is increased and considerable fogging can be tolerated without becoming a serious handicap. About four years ago I made an improvement in this type which now, in my opinion, is a very satisfactory piece of apparatus. Instead of using a rigid rubber frame, the holder for the glass is cut from a section of automobile inner tube. I have found size 5.25 to be the most satisfactory for the purpose. About 4 inches is allowed for the body of the frame and this 4 inch cylinder tapers back on either side to form a pair of straps. It is then only necessary to fit in the glass plate and tie the two straps together back of the head with the desired tension. Instead of tying the straps, they may be fastened with ordinary tube patches. In cutting the hind edges of the mask the contour of the user's face must be considered so that a tight fit will be secured. The diameter of the glass is about an inch less than the width of the tube when flattened. If the glass is slipped in only when the mask is worn the rubber retains its elasticity for a considerable length of time. My first mask of this type is now four years old, and shows no appreciable signs of wear. An outstanding advantage of this mask is that the pliable tube rubber fits the face snugly and does not become uncomfortable after being worn for several hours. It was found that much less fogging occurred if the glass and also the hands were thoroughly washed before the mask is used.

It early became apparent in my work that the handling of large numbers of turtles would be greatly facilitated by the use of a power-driven boat in conjunction with the water goggles, since it would not only permit the searching of much larger areas of the stream but would furnish a means of carrying the accumulated specimens. The method that has evolved is as follows. Beneath the bow of a 14 foot boat, powered by an outboard motor, a handle was fastened. The swimmer wearing the water goggles lies face down beneath the boat and holds onto the handle above him. From this position he can easily secure air at either side of the bow, and the entire bed of a small stream may be surveyed for great distances without fatigue to the observer. A system of signalling was then worked out between the operator of the boat and the swimmer. When a turtle was sighted several splashes of water were sent in the direction of the animal, calling for increased speed and indicating the proper direction. Continued splashes informed the operator of the course of the retreating quarry, and when the boat approached the turtle, the swimmer gave a push with his legs which sent him down almost on top of the turtle, which usually could be captured with a few strokes. This hard push-off from the boat also thrust the bow away from the swimmer, thus letting the operator know in which direction the swimmer had gone, and by the time the operator had made a circle in the direction indicated by the bow-kick the swimmer would usually have come to the surface with the turtle. After considerable practice in the team-

work involved in this system of turtle-catching it was easily possible to cover 3 or 4 miles of a stream in a single day without hardship.

If the water is perfectly clear, the water goggle is equally effective at all times of the day. However, if the water is carrying any appreciable amount of sediment, direct sunlight reflecting from these particles gives the water a milky appearance. In the absence of direct sunlight, fairly good results can be obtained in water which is quite turbid.

Late afternoon was found to be the period of greatest activity among the turtles. At this time they could frequently be hunted from the deck of the boat, a sighted individual being pursued by a quick dive, without the use of the water goggles. The chief advantages of this modification lay in the fact that the boat could be run at greater speed and more territory covered. Also, when the water was slightly turbid and a protracted underwater chase not feasible, the rapid dive from the deck afforded a better opportunity of approaching the turtle before it could lose itself in the murky water.

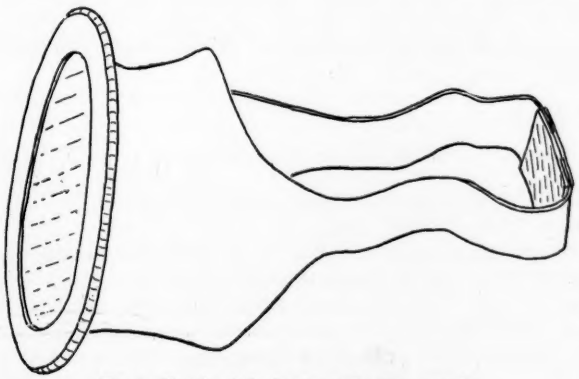

Fig. 1. Sketch of the home-made water goggle.

For making underwater observations at night, the water goggles are used in conjunction with an ordinary five-celled headlight, the headpiece being filled with water to avoid diffusion of the light from the enclosed air bubbles. When this is done, the headlight is as effective under water as above. The light may either be worn on the head or held in the hand. In working a relatively large stream at night, the boat may be anchored in midstream and a length of rope tied to the stern. If the collector fastens himself to the end of the rope, he may hold out an arm in the current and deflect his body from one side of the stream to the other.

Under proper conditions the possibilities of application of the water goggles in the study of aquatic organisms, vertebrate or invertebrate, are difficult to overestimate. Brock (1938) has described the use of the face mask in collecting and observing fishes. Recently at the University of Florida it has been used in conjunction with a headlight for the exploration of subterranean waters for crustaceans. The use of this combination has permitted the defining of the range of a rare cave crayfish genus, *Troglocambarus*

(Hobbs, 1942). The use of water goggles was also responsible for the discovery of a new species of turtle, *Graptemys barbouri*, described by Carr and Marchand (1942), from the Chipola River, Jackson County, Florida. On several trips made by members of the Department of Biology, University of Florida, to Mexico, water goggles have found extensive successful use in some of the clear streams there.

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Five Cases of Atypical Regeneration in the Adult Frog

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AMONG the amphibians the ability to regenerate lost structures has been attributed only to the salamanders and to pre-metamorphic tadpoles of the Salientia, for since the early work of Barfurth (1894) many investigators have reported the failure of the adult frog to regenerate amputated limbs. Recently, however, Rose (1944) has thrown new light on the problem by inducing limb regeneration in adult *Rana clamitans* by delaying the formation of new skin over the wound surface. It would appear from this work, therefore, that a stronger stimulus than simple amputation is necessary to bring into operation the mechanisms of regeneration in the adult frog. The only report we have discovered of natural, though limited, regenerative ability after simple amputation in adult frogs is that of Gadow (1901), who described two cases of atypical foot regeneration in *Rana temporaria*. During the past year we have encountered five cases of atypical limb regeneration in adult *Rana pipiens*. In each regeneration was very limited.

Our first two cases were obtained from a group of 6 frogs each of which had undergone amputation of the left fore foot and which were serving as controls in an experiment. Four months after the amputation, two of the six frogs exhibited atypical growths, 4 and 3 mm. long respectively, at the wound surfaces. As can be seen from the figure (A and B), these regenerates are morphologically undifferentiated. Since, however, they greatly resemble regeneration blastemas that had failed to complete morphogenesis, it was decided to section them for histological study. The stained sections revealed that the entire central area of each regenerate contained an irregular rod

of cartilage in an early stage of ossification. The remaining part of each regenerate was composed of masses of dense connective tissue.

C and D, in Figure 1, show our third and fourth cases of aberrant regeneration. These frogs were among 100 adult *Rana pipiens* received from Ward's Natural Science Establishment, and each had at some time previous to shipment lost the right hind foot. There developed on the wound surface of each of these limbs finger-like regenerates 6½ and 6 mm. long respectively. Sections through these structures revealed in each an irregular rod of cartilage forming in the center while around the cartilaginous rod and making up the rest of the regenerate were thick strands of connective tissue.

Fig. 1. Examples of atypical regeneration in *Rana pipiens*.

Our fifth case of regeneration was discovered in an adult *Rana pipiens* in a lot of 100 received from the General Biological Supply House. Two of the fingers of the left fore foot had each lost the distal joint, while a third finger was entirely missing. As can be seen from Figure 1E the two fingers with the missing distal joints each exhibited small regenerates 1½ mm. in length. As in the four cases described above, sections disclosed a central rod of cartilage in each, surrounded by layers of dense connective tissue.

It is clear that in the five frogs described above regenerative ability has not been absolutely lost, but the very limited nature of the regeneration indicates that this ability is relatively weak. Whether this is due to limitations of the limb field or of the blastema cells, or due to other factors, can not be determined from the present observations. The formation of cartilage in each of the regenerates seems to indicate that the blastema cells came under the influence of an evocator, although no properly organized parts of a limb skeleton can be recognized.

Furthermore, it is interesting that the five cases all showed regenerative activity at limb levels distal to the elbow or knee joint. We have amputated, in the past year, the limbs of 25 frogs at levels proximal to the elbow joint but have never observed signs of regenerative activity in such limb stumps. The number of cases is small for definite conclusions but these observations may be significant, especially so since Schotté and Harland (1943) have recently described a distal-proximal gradient of regenerative activity in the tadpole limb. The vestiges of such a gradient may still be present in adult *Rana pipiens*.

Finally, it is possible that there may be species differences among frogs and toads in the ability to undergo spontaneous regeneration, since the adults of only two species of frogs, *Rana temporaria* and *Rana pipiens*, have been observed to develop regenerates after simple amputation. More detailed analyses of limb regeneration in the adult frog are now being made under

controlled conditions with the hope that answers to these and other problems may be forthcoming.

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Kenyon College, Gambier, Ohio.

Herpetological Notes

A COLOR VARIANT OF THE EASTERN WORM SNAKE.—The normal coloration of the eastern worm snake, *Carphophis amoena amoena* (Say), is a salmon pink beneath, this color extending up the sides only to the second row of scales. The rest of the body above is a uniform chestnut brown.

On June 3, 1943, while working with a small, hooked band weeder in my garden in Arlington County, Virginia, I brought up from the soil an adult female worm snake of very striking coloration. The distinctive pink coloration normally limited to the under side had extended over the entire body. This snake was about 8½ inches in length and from head to tail was characterized by a glossy, immaculate pink hue with no hint of darker coloration upon the back.

This specimen was placed in soil in a large screened bucket through which drainage holes had been made, and sunk to ground level in the garden. Grubs and earthworms were placed on the soil from time to time. Some of these disappeared and it is assumed that they were eaten.

On July 8, 4 eggs were found to have been laid in the center of the container at a depth of about 3 inches from the surface, probably deposited within the last week of June. These were about the size of a small capsule, very elongate and rather irregular in shape, one end being somewhat larger. The dimensions of these were as follows: 19 x 8 mm.; 22 x 7 mm. (middle), 8 mm. at the large end; 19 x 7 mm., uniform in shape; and 20 x 7 mm. (middle), 9 mm. at the large end.

The little snake after laying seemed much smaller and more slender. Some time later it was found dead near the surface of the soil and decomposition had set in.

On several occasions the writer has unearthed specimens of this snake in his garden, but these have shown only the normal brown coloration above, and the ventral pink color. It is a burrowing serpent and when placed on the loose soil at once burrows from sight.

If the distribution of the pink and that of the brown in the coloration of this snake are localized by definite genetic factors or correl tions as seems probable, it would appear that the factor for brown had somehow failed to operate in this instance, so that the clear, ventral salmon pink color had assumed expression over the entire body.—H. A. Allard, *Beltsville, Maryland.*

NOTES ON THE SALAMANDERS OF BRITISH COLUMBIA.—Additions to the knowledge of the salamanders of British Columbia, accumulated since the publication of the annotated checklist of the amphibians of the Province by the junior author of the present notes (Cowan, 1937, Rep. Prov. Mus., 1936: 16–25), appear below.

Ambystoma macrodactylum Baird.—Since recording this species on Vancouver Island (Carl, COPEIA, 1942: 56), a single adult was found under a log at Savary's Pond, Langford, on March 3, 1942. Eggs of this species were taken in May, 1942, in a pond near Royal Oak, 5 miles north of Victoria.

The adult specimen, Prov. Mus. No. 635, measured 104 mm. in total length and in life had the ground color dark chocolate, dorsal stripe and spots dark olive-green, underparts dark gray with prominent dark lines marking abdominal veins, numerous small white spots on underparts, sides, and limbs. The dorsal stripe was fairly regular in outline, extending from the head along the back and most of the tail, breaking up on top of the head and on the tail into irregular spots.

Ambystoma gracile gracile (Baird).—The limits of the range of this salamander are yet unknown. In addition to research records by Dunn (COPEIA, 1944: 129) we can record Alta Lake, Mt. Seymour (4,000 feet), and Hope, on the lower mainland; and Jordan River, on Vancouver Island. Logier's Summerland record for this species (1932, Trans. Roy. Canad. Inst. 18: 316), based on larvae, should be re-examined.

A. g. gracile in British Columbia exhibits a puzzling diversity of color pattern and of size at metamorphosis. At sea level adjacent to Vancouver the majority of larvae metamorphose at the age of 12 to 14 months, almost all transforming prior to the second winter after hatching. Transformed specimens vary from 90 to 104 mm. in total length. Of twenty transforming specimens taken in Beaver Lake and Burnaby Lake near Vancouver in 1940-42, only one gave evidence of being 2 years old. It transformed at 140 mm. Adults from this region are uniformly brown, varying in tone from parchment brown to almost black and are without either light or dark spots. Of twenty individuals two had 9, sixteen 10, and two 11 intercostal grooves.

Larvae taken at Alta Lake (altitude 2,100 feet) and at the summit of Black Mountain (3,600 feet) showed no disposition to metamorphose during their first year. After periods of 2-4 years in confinement, two earthworms dipped in powdered beef thyroid were fed to each larva and all of them transformed within the month following. Adults from these localities are dark brown, plentifully spotted with black dorsally, and marbled with yellow on sides and abdomen. The costal grooves in fourteen individuals averaged 10.7 (10-11).

In these localities all breeding activity is carried on in permanent lakes and ponds. In the Vancouver district the ponds are marshy with mud bottom and with quantities of decaying vegetation. Foraging is most intensive after dark. At Alta Lake the conditions are very different. The parts inhabited by the salamanders have boulder bottoms without plant growth. Foraging is entirely nocturnal and the larvae pass the day under stones.

Jordan River records represent an unusual habitat for this salamander. Eggs were first noted on April 20, 1941, in a small ditch draining the road through a recently logged-off area at a point about 3 miles north of Jordan River. Many egg masses were found in this ditch and in other ditches and ponds in the vicinity, some freshly laid, others some weeks old, as indicated by the advanced stage of development and by the presence of symbiotic algae within the mass. In one pool about 2 feet in diameter, fed by a trickle of water, 14 egg masses were counted. Most of these were only half submerged, indicating that they had been laid when the water level was higher.

Closer examination of these trickles of water revealed *Ambystoma* larvae in some of the deeper portions. Captured specimens measured in millimetres as follows: 71, 66, 64, 60, 50, 48, 45 and 44. This area was visited again on May 20, 1942, and somewhat similar conditions were found. In addition to finding egg masses in small trickles of water several were found in "pot-holes" formed by uprooted stumps, and larvae were seen resting on the bottom in full view. When disturbed, some of these took refuge in the muddy bottom but most were easily netted. Mosquito larvae, hydrophylid beetles, entomostracans, and egg masses of *Hyla regilla* were found in the same pools.

On this date 10 larvae measured as follows: 85, 85, 67, 64, 64, 63, 61, 56 and 56 mm.

Between June 4 and 15 several of these larvae metamorphosed and measured as follows: 87, 75, 70, 66, 64 and 61 mm. In this area *A. gracile* apparently winters over as a larva and transforms to the adult while still of small size.

Sometime following the 1942 visit this area was burned over following logging operations. Many of the rivulets which formerly contained water were dry when visited in March, 1943, and no eggs or larvae were found. The larvae of this salamander are reported to be present in some of the larger streams of this district.

Dunn (COPEIA, 1944: 129) has defined the status of the more northern subspecies *A. g. decorticatum,* and has reviewed the material in this museum. Two of the three specimens from islands adjoining Hecate Strait were examined in life by the junior author. These were rich golden brown, the dorsum and head spotted with circular honey colored spots up to 2 mm. in diameter.

Ambystoma tigrinum melanostictum Dunn.—Two adult specimens of this western subspecies of tiger salamander were collected by Mr. Walter Steven, at Osoyoos, in September, 1941, and on September 29, 1942 (Prov. Mus. Nos. 621 and 690). Only two other locality records for this salamander, Midway and Summerland, were known in British Columbia. In life the upper surfaces and sides of head, body, tail and limbs have irregular and diffuse reed yellow blotches with a fuscous-black net-work between the blotches; underparts reed yellow with diffused bars of fuscous-black, deep olive-gray around eye; iris flecked with gold.

Dicamptodon ensatus (Eschscholtz).—The Pacific giant salamander appears to be found in British Columbia only in the extreme southwestern portion of the mainland, where it has been recorded from Chilliwack Lake, Sumas Lake and Sweltzer Creek, near Cultus Lake. On May 30, 1942, the authors collected two larvae of this species in a small mountain stream on the western shore of Cultus Lake, 1½ miles south of Sweltzer Creek. These larvae were light brown with darker reticulations. They were exceedingly difficult to see when resting on the gravelly bottom of a pool among the dancing shadows produced by the running water. When disturbed, they moved slowly and disappeared beneath nearby rocks.

One of these specimens measures 125 mm. in length (Prov. Mus. No. 641); the other in the Museum of Zoology, University of British Columbia, measures 119 mm.

Ensatina eschscholtzii Gray.—A specimen of the brown salamander (Prov. Mus. No. 484) was taken on Gambier Island, Howe Sound, about 15 miles N.W. of Vancouver in September, 1933, by G. P. Holland of the Dominion Entomological Laboratory, Kamloops. Two others were captured on the same island by us in March and April, 1943. These are in the Museum of Zoology, University of British Columbia. This salamander is abundant in the Vancouver region in second growth deciduous woodland and extends inland at least to Cultus Lake, where four specimens were taken on May 29 and 30, 1942.—G. CLIFFORD CARL, *Provincial Museum, Victoria,* and IAN MCTAGGART COWAN, *Dept. Zool., Univ. British Columbia, Vancouver, British Columbia.*

POSSIBLE INTRODUCTION OF ARGENTINE TOADS INTO FLORIDA.—In the Rio de Janeiro newspaper, *O Globo,* issue of March 8, 1944, was printed a Reuters dispatch of the same date, in regard to the shipment of live toads from Argentina into the United States. An exact translation of the dispatch, but with corrections of the somewhat garbled scientific names, follows: "*'La Nacion'* (a Buenos Aires newspaper) has received the following interesting telegram from its correspondent in Tucuman: In response to a request from the United States Sugar Co., of Cleveland, United States, the Agricultural Experiment Station of Tucuman, has shipped, by air, a lot of seventy toads of the species *Bufo paracnemis,* known in the Chaco and Corrientes by the name *cururú,* and *Bufo arenarum,* the common toad, both considered to be very useful in the destruction of insects injurious to sugar plantations. The North American Government gave aerial transport priority to these batrachians, which are travelling as war material, because of the importance their action will have in the canefields of the state of Florida, where they are being sent." [The same information appears in The American Weekly for August 13, 1944.—Ed.]

Florida herpetologists, and the local population of *Bufo terrestris* and *Bufo quercicus,* will please take notice.—GEORGE S. MYERS, *Museu Nacional, Rio de Janeiro, Brazil.*

A NEW NAME FOR A BRAZILIAN *MABUYA*.—The species of skink found on the island Fernando Noronha is very distinct from the mainland Brazilian forms; it appears in the literature as *Mabuya punctata* Gray, as in Burt and Burt (1933) and Dunn (1936). Andersson, however, (1900, Bih. Svensk. Akad. Handl., 26, Pt. IV, No. 1: 15) refers Linnaeus' *Lacerta punctata* to the African *Mabuya homalocephala*, with the proposal that the name *maculata* Gray take the place of the preoccupied *punctata* of the same author. *Tiliqua maculata*, however, is a synonymn of *Mabuya mabouya mabouya* Lacépède.

There seems to be no other name available for the Fernando Noronha species, and I propose that it be renamed:

Mabuya ***atlantica***, nom. nov.

Tiliqua punctata Gray, 1838, Ann. Mag. Nat. Hist., (1) 2: 289—not *Mabuya punctata* (Linnaeus).
Mabuia punctata Boulenger, 1887, Cat. Lizards Brit. Mus., 3: 160, pl. 9, fig. 1 (part); *idem*, 1890, Journ. Linn. Soc. London, Zool., 2: 481; Boettger, 1893, Kat. Rept. Senck, Ges., 1. Teil: 97.
Mabuya punctata Burt and Burt, 1931, Bull. Amer. Mus. Nat. Hist., 61: 302; *idem*, 1933, Trans. Acad. Sci. St. Louis, 28: 86; Dunn, 1936, Proc. Acad. Nat. Sci. Phila., 87: 535.

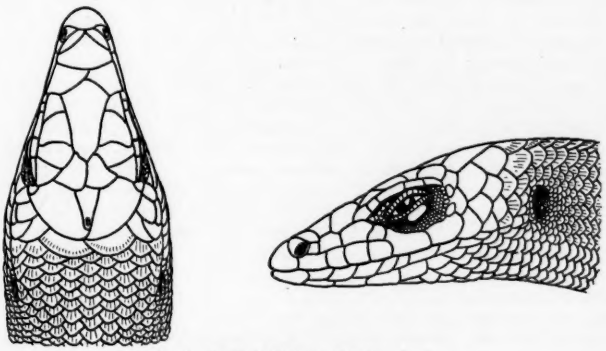


Fig. 1. Head of *Mabuya atlantica*, × 3.

In addition to the type specimens collected by H.M.S. Chanticleer sometime previous to 1838, the specimens on record include only the ten collected by the Fernando Noronha expedition of Ridley and Ramage in 1887 for the Royal Society, three in the American Museum of Natural History collected by Robert Cushman Murphy, and three collected by Lieutenant R. B. Finley, Jr. One of the latter specimens, presented to the Chicago Natural History Museum for the purpose, is herewith figured; the configuration of the head shields differs appreciably from Boulenger's figure.—KARL P. SCHMIDT, *Chicago Natural History Museum, Chicago 5, Illinois.*

RECOVERY FROM SERIOUS INJURY IN THE PAINTED TURTLE.—A female painted turtle, *Chrysemys picta*, measuring 12.6 cm. in plastron length, collected in the City Lake, Carbondale, Illinois, May 17, 1940, had been recently injured with a rifle shot. The bullet had entered the 2nd right costal and considerable bleeding had occurred in the vicinity of the wound. Although the injury appeared serious the turtle was marked and released.

This turtle was subsequently recovered four times during the next two years. At the time of the first two recoveries (June 6, 1940; July 19, 1940) the wound was open and there was little evidence of repair. Recovered again on May 22, 1941, there was some evidence of scar tissue developing about the bullet hole and the fractured plate was healed. The turtle appeared to be normally active. The turtle was removered again on June 18, 1942. The injury was completely closed and the turtle gave no evidence of being handicapped.—FRED R. CAGLE, *Peterson Field, Colorado Springs, Colorado.*

ERYTHROCYTE COUNTS IN COLORADO *AMBYSTOMA*.—In a preliminary study of altitudinal morphological variations of *Ambystoma tigrinum*, the first of the undersigned authors collected and examined specimens from altitudes of 6,000 feet and 10,000 feet above sea-level in Boulder County, Colorado. This study, made in June and July, 1939, was primarily an investigation of erythrocyte counts, and was under the direction of the second of the undersigned, who has been authorized to prepare this note for publication. It seems worthwhile to place the data on record since such counts have not to our knowledge been reported.

It was thought probable that erythrocyte counts in individuals from the higher altitudes would prove to be higher than in those from the lower elevation. The average count was indeed slightly higher in salamanders from 10,000 feet than in those from 6,000 feet, but the variation among the individuals from the same altitude was so great that no statistical significance can be attached to these results. This variation is in line with previous references (G. K. Noble, Biology of the Amphibia, New York, 1931: 180) to the great variation in red-cell counts in amphibia in general. Individuals must be carefully grouped by size, sex, age, season, and perhaps other criteria, before comparisons based on another variable, e.g., altitude, may legitimately be applied. Large series must be used, and even then considerable individual variation may be found. In the observations here reported comparable series were not available from the two altitudes.

All blood samples for these observations were taken directly from the atria of anesthetized animals in which the heart was still beating. The average of two counts of a square millimeter in a Levy-Hauser counting chamber was taken for each animal, dilution being with Hayem's solution. (It is realized that more counts should have been made from each individual.) The adult, nearly adult, and larval specimens were all collected from ponds, the former in shallower portions. A salamander was considered "adult" if the gills were entirely gone and the gular fold grown fast to the body, "nearly adult" if only a remnant of the gills persisted. The larvae on which counts were made ranged from 165 mm. to 218 mm. total length. Sex was determined by dissection. Examination of specimens collected at 6,000 feet was carried out at Boulder (altitude 5,400 feet); those collected at 10,000 feet were examined at University of Colorado Science Lodge (9,500 feet).

The red-cell counts, per cubic millimeter, were as follows:

Altitude 6,000 feet. Males: larvae (5) 136,000–174,000 (ave. 158,000); nearly adult (1) 172,000; adult (2) 176,000 and 177,000. Females: larvae (3) 100,000–162,000 (ave. 130,000); nearly adult (1) 186,000; adult (5) 129,000–254,000 (ave. 179,200). Average all counts (17 individuals) at 6,000 feet, 163,900.

Altitude 10,000 feet. Males: larvae (0); nearly adult (5) 130,000–229,000 (ave. 171,600); adult (0). Females: larvae (0); nearly adult (4) 139,000–226,000, (ave. 184,750); adults (0). Average all counts (nine individuals) at 10,000 feet, 177,400.

The difference in averages from the two altitudes is not important. This difference is not statistically significant, and, furthermore, the averages were obtained from individuals not strictly comparable in age.—ROBERT B. MYERS, *United States Army*, and GORDON ALEXANDER, *University of Colorado, Boulder, Colorado.*

FURTHER RECORDS OF THE LEATHERBACK TURTLE FROM NEW ENGLAND WATERS.—From time to time I have reported the capture of *Dermochelys coriacea* off the coast of New England. This pelagic giant has a wide range in both oceans, reaching north to Vancouver Id., British Columbia, and Halifax, Nova Scotia. Its huge size makes it of dramatic interest and its capture is usually recorded in the press or elsewhere. Captures of smaller species of sea-turtles, unfortunately, often go unnoticed and thus their records are lost.

Four authentic records since my last report in COPEIA are here listed:

Aug. 1, 1939. Taken off Boothbay Harbor, Me.
July 29, 1940. Taken off New Harbor, Me.
Aug. 9, 1942. Taken off Newburyport Harbor, Mass.
Aug. 3, 1944. Taken off Pemaquid Point, Me.

H. L. BABCOCK, *Boston Society of Natural History, Boston, Massachusetts.*

HAMADRYAS PREOCCUPIED FOR THE KING COBRA.—In a recent publication (Bull. Amer. Mus. Nat. Hist., 81: 292) I had occasion to point out dentitional differences that exist between the king cobra and other cobras more closely related to *Naja naja*. Because there are many other important characters in the skull, scutellation, and visceral anatomy, as well as in penial characters, that indicate a totally different line of descent from some earlier elapid stock, I advocated recognition of the genus *Hamadryas* for the species *hannah*. Moreover, it was pointed out that the king cobra is not nearly so closely related to *Naja* as are members of the genera *Boulengerina* and *Hemachatus*, recognized by Boulenger and since accepted as valid.

In using the name *Hamadryas* I carelessly overlooked the fact that *Hamadryas* of Cantor, 1836, is preoccupied by *Hamadryas* of Hübner, 1806. This oversight has been brought to my attention by W. P. Comstock in his paper on the insects of Porto Rico and Virgin Islands (Sci. Surv. of Porto Rico and the Virgin Islands, 12: 471) in which Hübner's name is applied to a genus of butterflies. Of the various generic names that have been applied to the king cobra only *Ophiophagus* of Günther, 1864 (type species *elaps* = *hannah*), seems to be available. Hence the proper name of the largest living elapid should be *Ophiophagus hannah* (Cantor).—C. M. Bogert, *The American Museum of Natural History, New York 24, New York.*

A ONE-EYED SNAKE.—While examining a series of Butler's garter snakes, *Thamnophis butleri* Cope, the writer found a case of an apparent developmental failure of the left eye. This condition caused a number of changes in the scutellation of the left side of the head of the specimen. The left supraocular is reduced to about one-half of the size of the right, and it descends laterally for a slight distance. The postoculars are reduced from three to two and are much forward of the normal position. The preocular is reduced vertically to about two-thirds of the size of the right preocular, and is slightly posterior to its normal position. The pre- and postoculars, together with a small part of the supraocular, completely cover the orbital region. Because of the anterior position of the postoculars, the anterior temporal has been slightly elongated and moved forward for a short distance; this admits a middle temporal, making the temporal count 1-1-2. The temporals on the right side are 1-2. The supralabials number seven on the right side, and six on the left; however, between the 5th and 6th left supralabials there is a labial that does not reach the lip line. The 3rd and 4th left supralabials are a little higher and less wide than those on the right. Otherwise, the specimen (UMMZ, 73214b) presents a normal scutellation: scale rows, 19-19-17; ventrals, 136; caudals, 55; total length, 224 mm., tail length, 50 mm. The snake, a female, was taken at Pt. Place, Monroe County, Michigan.—Albert G. Smith, *Wright Field, Dayton, Ohio.*

INTERGRADATION OF *LAMPROPELTIS CALLIGASTER* AND *L. RHOMBOMACULATA* IN MISSISSIPPI.—A recent review of specimens of *Lampropeltis calligaster* and of *Lampropeltis rhombomaculata* collected on the Survey Project in Mississippi from 1937 to 1941, together with a specimen collected in 1919 by Prof. H. A. Denee in Lafayette County, indicates intergradation of these two forms in northeastern Mississippi. Specimens collected in Jones, Pike, and Pearl River counties have all the characters of *rhombomaculata*. Some of those collected in the northeastern part of the State have characters intermediate between *rhombomaculata* and *calligaster*, while others from this same region have exclusively *calligaster* characters or exclusively *rhombomaculata* characters.

Specimens that have 25 rows of scales on the middle of the body, or that have 9 inferior labials, or those with both of these characters, have been classified as *calligaster*; those with 21 or 23 rows of scales on the middle of the body and with 8 inferior labials have been classified as *rhombomaculata*. Those referred to *calligaster* (except Ar [1]–2048) are dark brownish-gray, and those classified as *rhombomaculata* (except Ar–903) are light brown without gray. The specimens of both forms have 7 upper labials, except UMMZ 53657, which has 7–8; all have a single preocular and two postoculars; and all have two anterior temporals.

[1] Symbols used in this note with reference to reptile collections are: Ar—State Game and Fish Commission, Jackson; Br—Biology Museum, University; Lr—Southwest Junior College, Summit; Mr—Jones County Junior College, Ellisville; Nr—Pearl River Junior College Museum, Poplarville; UMMZ, Museum of Zoology, University of Michigan.

Specimens Ar–1289 and Mr–211 from Pearl River County and specimen Mr–172 from Jones County are light brown, have 21 scale rows on the middle of the body, and have dorsal blotches with straight or convex anterior and posterior margins. Ar–322 from Tishomingo County is also light brown and has 21 scale rows on the middle of the body and dorsal blotches with convex anterior and posterior margins. Ar–903 from Chickasaw County is gray; has 23 scale rows on the middle of the body and dorsal blotches with straight to slightly concave anterior and posterior margins.

Specimens Ar–2048 from Chickasaw County and Br–46, Br–194, and Br–195 from Lee County are brownish-gray with 25 scale rows on the middle of the body. Br–194 has 9 inferior labials on both sides and Br–195 has 9 on one side and 8 on the other. Ar–2048 and Br–46 have 8 inferior labials on both sides. In Br–195, the dorsal blotches have convex to straight anterior and posterior margins, while in Br–194 and Br–46 the margins are usually straight but tend to become convex on some blotches and concave on others.

Lampropeltis calligaster calligaster

Cat. No.	Locality	Date and Collector	Sex	Scale Rows	Ventrals	Caudals	Inf. Labs.	Transv. Splotches	Total Length in mm.	Tail Length in mm.
Ar-2048	Chickasaw Chookatonkchie Creek Area	Sept. 9, 1941 H. L. Owen	♂	23-25-21 or 19	213	50	8	34+9	267	38
Br-46	Lee County 3½ mi. NE Shannon	Apr. 19, 1937 Survey Project	♂	25-25-19	213	47	8	32+9	840	117
Br-194	Lee County 3 mi. NE Shannon	Oct. 29, 1937 A. Walker	♂	23-25-19	211	48	9-9	35+10	711	108
UMMZ 53657	Lafayette Co. Near University	Mch. to June, 1919 Prof. H. A. Dennee	♂	23-23-19	210	45	9	37+9	992	127
Br-195	Lee County 3 mi. NE Shannon	Oct. 29, 1937 K. Woolridge	♀	23-25-19	219	39	9-8	32+10	756	89

Lampropeltis calligaster rhombomaculata

Ar-903	Chickasaw County Old Union Church	July 17, 1940 H. L. Owen	♂	23-23-19	211	49	8	34+8	686	83
Nr-211	Pearl River Co. 21 mi. SW Poplarville	Mch. 21, 1938 Survey Project	♂	21-21-19	191	52	8	39+10	508	76
Ar-322	Tishomingo Co. 14 mi. NW Highland	Apr. 26, 1937 Survey Project	♀	19-21-19	191	44	8	36+9	199	31
Ar-1289	Pearl River Co. 14mi. NW Poplarville	June 20, 1940 W. D. Lewis	♀	21-21-19	201	40	8	36+9	533	69
Mr-172	Jones County Boguehoma Area	Oct. 30, 1940 B. A. Bloodsworth	♀	21-21-19	186	45	8-7	38+9	673	96
Lr-1266	Pike County	Feb. 15, 1938 W. R. Parsons	♀	21-21-19	196	36	8-9	37+9	686	76

Specimen UMMZ 53657, from Lafayette County, has 23 scale rows on the middle of the body, 9 inferior labials (6th largest), and dorsal blotches with concave anterior and posterior margins. This specimen is presumably the specimen on which Blanchard based the inclusion of Mississippi in the range of *calligaster* in his *Key to Snakes of the U.S., Canada, and Lower California* as this specimen was sent to the Museum of Zoology of the University of Michigan, a collection to which Dr. Blanchard had access. In listing this specimen among others sent to the University by Prof. Dennee, Doreen Potter refers it to *calligaster* (1920, COPEIA, 86: 83). Stejneger and Barbour in their check lists presumably included Mississippi in the range of *calligaster* on the basis of Blanchard's statement of the range as this is the only published reference to the occurrence of the species in this state. Mississippi has not heretofore been included in the range of *rhombomaculata*. The presence of both forms in this state, with strong indications of intergradation, suggests that they should have sub-specific status as I have indicated in the table.—FANNYE A. COOK, *Mississippi Game and Fish Com., Jackson, Mississippi.*

LAMPROPELTIS TRIANGULUM ANNULATA FROM KERR COUNTY, TEXAS.—In June, 1941, a female of the little known *Lampropeltis triangulum annulata* (Kennicott) was secured 16 miles south of Kerrville in Kerr County, Texas. Previous records for this snake place it considerably to the south, principally in the Lower Sonoran Zone; whereas the locality for the present specimen is in the Upper Sonoran, cedar-oak association at about 1,500 feet elevation.

The dorsal color of this specimen is more or less typical, with yellow bands about two scales wide bordered by black on either side. The black in turn borders the red saddles, which are interrupted on the belly by a black area connecting the black bands. There are seventeen red saddles on the body and three on the tail. There are 21 scale rows; 198 ventrals, 41 caudals, 7 labials, 9 infra-labials on the left, 8 on the right. There are two pairs of postgenials, the anterior of which are larger. The temporals are 1-2. This specimen is unique in lacking a loreal so that the ocular borders the postnasal. The eye borders labials 3 and 4. There is one preocular, and there are two postoculars on each side. The prefrontals border on the middle third of the second upper labial. The nasal is divided, the posterior nasal bordering on the posterior portion of the first upper labial and on the anterior third of the second labial. The lower postocular is between the fourth and fifth labials. The anal scale is entire. The finely striated dorsal scales, except the first two rows, have two small pits near the posterior angle.—STANLEY AND DOROTHEA MULAIK, *Biology Department, University of Utah, Salt Lake City, Utah.*

PLETHODON RICHMONDI IN GREENE COUNTY, OHIO.—*Plethodon richmondi* Netting and Mittleman has been reported in western Ohio only at Cincinnati, Hamilton County. On May 14, 1944, thirteen specimens were collected in Glen Helen, Yellow Springs, Greene County, approximately 60 miles NNE of Cincinnati in central Miami Valley. The specimens are deposited in the Dayton Public Library Museum.

At Glen Helen there is a deep glaciated ravine with limestone outcroppings exposed on both east and west sides. The surrounding area, and the talus slopes within the ravine, are heavily wooded. A permanent stream, Yellow Springs Creek, flows south through the ravine. The upper outcropping layer of limestone is Cedarville, and below this is the Springfield, which weathers more rapidly and an undercut has thus been formed beneath the Cedarville. On the crest of the talus of slope on the west side of the ravine, below the overhanging ledges, eight specimens of *Plethodon richmondi* were taken. None were taken between slabs of rock, or in the seepage areas where water had collected. All were beneath limestone slabs on dry, crumbly earth. Never was more than one salamander found under a single rock.

Three more specimens were found near this first group, under limestone slabs on the talus slope beyond the outer edge of the overhanging rocks, on the earth. Another specimen was collected on top of a limestone slab, beneath a small piece of bark, near the second group of specimens. This was the only individual not found underneath a limestone slab.

One specimen was found under a small rock on black earth near ant hills on the east side of the ravine, part way up the face of the outcrop on a tiny talus slope on a limestone shelf. Twenty feet away a large *Eurycea longicauda longicauda* was taken in a similar habitat. No specimens were found in the lower three-fourths of the talus slope. —JOHN THORNTON WOOD, *Dayton Public Museum, Dayton Ohio.*

RATE OF TRAVEL OF THE WOOD TURTLE.—A wood turtle, *Clemmys insculpta* (LeConte), was taken alive on July 2, 1943, in the Connecticut River valley at South Amherst, Massachusetts. The specimen weighed 940 grams, the carapace was 186 mm. long and 136 mm. wide. On July 8, the turtle was photographed and released. It departed in a northeasterly direction, traveling down a grassy 15 degree slope toward a small artificial pond less than 1000 feet away. At the end of 25 minutes the wood turtle had traveled 450 feet (measured by pacing), a speed of approximately one-fifth mile per hour. The apparent hasty departure of the animal from the location of its captivity suggests that one-fifth mile per hour was the maximum traveling speed of this individual.—GORDON T. WOODS, *State Board of Fisheries and Game, Hartford, Connecticut.*

DEKAY'S SNAKE IN MARYLAND.—*Storeria dekayi* (Holbrook) is known to be widely distributed in Maryland, as may be seen from the *Snakes of Maryland* (Kelly, 1936), but because of its secretive habits it is not commonly observed.

In July, 1937, a single specimen was located under fallen oak leaves about 300 yards from the edge of the county highway 6 miles out of Solomons, in Calvert County. This was a female, 133 mm. long. It was brought into the laboratory and kept amply supplied with earthworms and water. On August 17, 1937, it gave birth to 27 living young. The average length of the 27 was 22 mm. They were black with a fairly distinct white ring on the neck.

In June of the following year, four specimens were located in the same vicinity, separated from each other by distances of 65 to 125 yards. They were obtained by searching carefully under fallen oak leaves. The largest of these individuals measured 123 mm. in length, one 101 mm., another 96 mm., and the smallest 65 mm. This juvenile specimen was pale gray above, merging to grayish-black laterally.

During July, 1938, two were collected in the vicinity of Pasadena, Anne Arundel County, in pine woods. One 124 mm. long was under a board adjacent to a foot path, the other, 97 mm. long, was covered by pine needles and trash lying in a ravine. Subsequent collections in this same area in 1939 and 1940 failed to reveal additional specimens. In August, 1941, a single female 130 mm. long, accompanied by 13 young that averaged 33 mm., was collected from inside an automobile tire on a dump about 40 yards from the Pasadena locality.

The collection in March, 1943, of a single female (110 mm.) at Hollywood, Berwyn, Prince George County, stimulated additional search in that area. This female, uncovered by a lawn mower in the lawn, was quite active in spite of the fact that the weather was cold and damp. Further search failed to reveal more until May, when a single specimen (119 mm.) was observed about a mile away.

During May, 1943, nine additional specimens were collected from a trash dump about 2 miles from the University of Maryland in College Park. These were collected separately, at distances from 4 to 10 feet apart, from beneath boards or debris. A detailed survey of a wooded area southwest of the Maryland campus, in July, 1943, resulted in the collection of seven individuals. One, a female 142 mm. long and apparently pregnant, was picked out of a log. Three were collected from a dump containing paint cans, paper, and other trash about 200 yards from the first collection. Of these two were males (96 and 102 mm.) and the third was a female (154 mm.). Four more, located under fallen leaf cover, were widely separated from each other by distances of 300 to 500 yards. They were 107, 122, 131, and 116 mm. long.

This indicates that *Storeria dekayi* is more abundant in this area than is generally supposed. All measurements are total lengths to the nearest millimeter, made by extending the living snake on a metal rule.—ROBERT A. LITTLEFORD, *Department of Zoology, University of Maryland, College Park, Maryland.*

THE SPADEFOOT TOAD IN OHIO.—The spadefoot toad, *Scaphiopus h. holbrookii* (Harlan), has not previously been reported as occurring in Ohio, although Green and Richmond 1940: COPEIA, 127) reported large numbers of them as having been found at Huntington, West Virginia, immediately across the Ohio River from near the southern tip of Ohio. Stejneger and Barbour (1939, Checklist of Amphibians and Reptiles) define the range as "as far north as Martin County, Indiana." Martin County, Indiana, is in the same latitude as Lawrence County, Ohio, which is across the Ohio River from Huntington. There is no reason why *Scaphiopus* should not occur on the north side of the Ohio River as well as on the south side of it. Systematic collecting, however, had failed to verify its presence in Ohio.

On May 24, 1943, quite accidentally, a single specimen of *Scaphiopus* (No. A-1257, Ohio University Zoology Collection) was turned up in a garden on the bank of the Hocking River near Athens, Ohio, about 65 miles north of Huntington, by air, or about 125 miles via the Ohio and Hocking rivers. Although intensive collecting in this vicinity had not previously disclosed the presence of *Scaphiopus*, I believe it very probable that observations at the proper time will verify at least limited populations of the spadefoot toad in Athens, Meigs, Gallia, and Lawrence counties.—H. T. GIER, *Ohio University, Athens, Ohio.*

COLOR CHANGE IN A FORK-TAILED ANOLE.—The common anole of the southern United States (*Anolis carolinensis* Voigt), like many other species of lizards, may exhibit autotomy. When grasped by the tail it may free itself quickly by breaking off this tail just in front of the grasped portion. The tail breaks at predetermined planes which are easily recognized externally by differences in the scale patterns (Fig. 1). Internally each breakage plane coincides with a special septum that divides each caudal centrum (except the first six or seven) into an anterior and a posterior portion.

A new tail grows out, replacing the lost portion, but it differs from the original tail in that no breaking planes are indicated by the scale pattern and no true vertebrae are differentiated. When this new tail is first formed, it also lacks the capacity to change color, so that regardless of whether the body and original tail are brown or green, the regenerated tail remains brown until growth of the new tail is complete. A bright green lizard with a brown tail is a striking sight.

In an unusual tail regeneration a full grown male *Anolis* collected in New Orleans by William Wiedorn had a forked tail, evidently formed by a partial break of the original tail, which had remained attached on the left side. At this break a new tail had regenerated in line with the body axis, thus healing the wound and firmly attaching the original tip. The tip of the unregenerated left prong had subsequently been broken off and a new tip regenerated. The fork was thus made up of a regenerated right prong about an inch long, and a left prong, consisting of a basal half inch of the original tail and a distal half inch of regenerated tail.

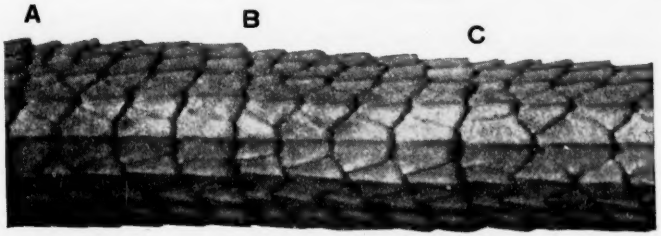


Fig. 1. Photograph by Roy Trahan showing breakage planes on tail of *Anolis carolinensis*.

In the brown phase the lizard was brown all over, while in the green phase the right prong remained brown and the left prong was green in the basal unregenerated part with the regenerated tip brown.

The corium of the skin in *Anolis* has been shown to have an oil droplet layer, a xanthophore layer and a leucophore layer, which function either as light filters or reflecting layers or both. Brown pigment, the only pigment present in most of the skin, is located in chromatophores, which have processes reaching through the above mentioned filter layers to the epidermis.

It has been shown that in the presence of intermedin, a secretion of the intermediate lobe of the pituitary gland, the brown pigment is dispersed into the various processes of the chromatophores so that it appears above the filter layers of the corium. A lizard then appears brown. In the absence of intermedin the brown pigment granules are withdrawn into the body of the chromatophore beneath the filter layers. The light that then reaches the brown pigment must pass through these filter layers, the unabsorbed rays are reflected back through the skin, and we see them as green. (von Geldern, 1921, Proc. Calif. Acad. Sci., 10: 77–117.)

The failure of the regenerated tail to appear green would suggest an absence of one or more of these filter or reflecting layers in the regenerating skin. That these layers are finally regenerated is indicated by observations of older regenerated tails, which do have the ability of becoming green in harmony with the rest of the body.—F. H. Wilson, *Departments of Zoology and Tropical Medicine, Tulane University, New Orleans, Louisiana.*

NOTES ON SOME FROGS AND TOADS OF BRITISH COLUMBIA.—Much is still to be learned regarding the occurrence and distribution of amphibians in British Columbia. Since the appearance of an annotated check-list in 1937 by the junior author (Rep. Prov. Mus., 1936: 16–25), a number of additional records have come to hand. Field work in the Peace River district of northeastern British Columbia in 1938 added *Pseudacris nigrita septentrionalis* (Boulenger) to the list of species known to occur in the Province (Cowan, 1939, Occ. Papers B.C. Prov. Mus., 1: 92–93). Notes on some other species of Salientia are presented here.

Ascaphus truei Stejneger.—Hitherto this amphibian has been recorded from Cultus Lake, near Chilliwack, B. C. (Ricker and Logier, COPEIA, 1935: 46) and from Hatzic and near Lytton (Slipp and Carl, COPEIA, 1943: 127). On June 2, 1942, we collected both larvae and adults of this species in Sunshine Creek, which flows into Indian Arm, Burrard Inlet, about one-half mile north of Woodlands summer resort, approximately 8 miles northeast from Vancouver.

The first larvae discovered were about 200 yards up the stream from salt water and at an elevation of less than 100 feet. Since they measured about 25 mm. in length and lacked hind limb buds, they were probably completing their first year of life. Further up the stream above a fork, a group of at least five tadpoles of a similar size was observed in one pool. After night fall, the lower part of the stream was again explored by flash light and three larger larvae and one pair of adults were taken. The larvae, one of which measured 53 mm. in length, possessed well-developed hind limb buds indicating that they were probably completing their second year of life. The adults, both females, measured 28 and 29 mm. in length.

Four *Ascaphus* tadpoles, two yearlings and two 2-year-olds, were transported alive from Sunshine Creek to the Provincial Museum where they were placed in a trough and provided with running water from the city supply. Several algal coated stones and pebbles from a nearby stream were placed in the trough the following day to provide both shelter and food. One of the larger tadpoles died on June 10 and one of the smaller larvae on August 16.

On August 13 the surviving two-year-old larva had four limbs. The hind legs were strongly developed and were used occasionally to push the animal along the bottom or over the stone surfaces; the fore limbs were used for support of the head and to a slight extent for locomotion. The sucker was reduced in size but was still used for attachment. The total length of the larva was 48 mm.

On September 2 the metamorphosing larva showed no signs of the oral sucker; the eyes were prominent and the limbs were well-formed. The tail was occasionally used, but locomotion was largely accomplished by the legs. The general color was blackish-green with lighter spotting; the sides of the tail had a purplish sheen; small yellowish-green spots were present on the sides of the body and on the upper surfaces of the limbs. A dark narrow bar was present across the head between the eyes; in front of this the head and snout was lighter than the rest of the body. The throat and belly was purplish while the undersurface of the limbs was flesh colored. The cloacal projection was prominent, indicating that the specimen was a male.

Occasional movements of the throat and lower jaw suggested that buccal respiration was taking place; the larva was not seen to rise to the surface for air. The specimen measured 37 mm., of which the tail amounted to 18.5 mm. This transforming individual was accidentally lost before metamorphosis was complete.

On August 8, 1942, 20 larvae were collected in a creek near Cultus Lake Hatchery, Cultus Lake, British Columbia, by Mr. D. Leavens. The tadpoles ranged in total length from 32.5 to 42.5 mm. and all but the smallest individual had hind limbs in various stages of development. Two had well-developed fore-limbs as well and showed some reduction in the size of the sucker.

An adult male taken 6 miles up Indian River about 30 miles north of Vancouver on November 5, 1942, seems to constitute the northernmost record of this species in the vicinity of the coast.

Bufo boreas boreas (Baird and Girard).—During field work on the northern coast of British Columbia in the summer of 1939, toads of this species were found to be common on many of the larger islands. They were observed, but not collected, upon Calvert and Hunter islands and specimens preserved from Spider Island, Dufferin Island and Princess Royal Island.

The presence of this amphibian on these islands is convincing testimony to the frequent and effective transport facilities serving to populate the islands from the adjacent coasts despite heavy seas and strong currents. Raft transportation as a result of extensive land slides is regarded as the most important medium for animal dispersal in the region.

Rana pretiosa pretiosa (Baird and Girard).—In southern British Columbia *Rana pretiosa* and *Rana aurora* occupy geographically complementary ranges. Thus *pretiosa* is recorded from many localities east of the Coast Range and reaches the coast north of Prince Rupert, while *aurora* is known only from the coast of extreme southwestern British Columbia and the adjacent islands. Logier (1932, Trans. Roy. Can. Inst., 18: 323) cites a record of *pretiosa* on Sumas Prairie in the center of the area occupied by *aurora*. It is significant to record the capture of two recently transformed specimens of *pretiosa* on Nicomen Island, in the Fraser River some 50 miles east of Vancouver, on October 20, 1941. The occurrence of these two species on the same general territory provides an opportunity to investigate their ecological relations.

Rana catesbeiana Shaw.—Upon the collapse about 10 years ago of an attempt to raise the bullfrog commercially for the domestic market in nearby Vancouver a number of individuals were liberated not far from Burnaby Lake. In this, in adjacent Deer Lake and in Still Creek, tributary to Burnaby Lake, the bullfrog is now the most abundant amphibian. Spawning apparently takes place in the sluggish stream as well as in the shallower parts of the lakes and in 1943 began about mid-April. Tadpoles swarm among the aquatic vegetation. At this latitude the larva spends at least two years as a tadpole and reaches a length up to 6½ inches before transforming. The largest adults taken measure 160–170 mm. after preservation.

Rana clamitans Latreille.—The green frog has been imported into this Province by shop proprietors and other dealers in aquatic life and recently it has become established in the region around Victoria on Vancouver Island. According to one proprietor of aquatic gardens, tadpoles of the green frog and of the bullfrog were first brought into the country from dealers in the middle eastern states about 10 years ago. Since that time more have been imported from time to time by various individuals or concerns and many have been sold to owners of artificial ponds. Some of the tadpoles have metamorphosed and the frogs have thrived and bred readily in the ornamental pools, spreading to the natural ponds in the district. At the time of writing, green frogs have been collected from natural ponds on the outskirts of Victoria and are said to occur in Swan and Lost lakes in the same district; a pair of adults was taken at King's Pond, Saanich, on September 19, 1941.—G. Clifford Carl, *Provincial Museum, Victoria,* and Ian McTaggart Cowan, *Dept. of Zool., Univ. of British Columbia, Vancouver, British Columbia.*

OVIPOSITION BY *PHRYNOSOMA SOLARE*.—Two adult *Phrynosoma solare* Gray were purchased in Arizona and kept as pets in North Dakota during the summer of 1936. Possibly in response to unusually high temperatures, one lizard laid about six eggs. The lizard was immediately placed in a box of warm sand, where it continued its oviposition until a total of twenty-eight eggs had been laid.

The manner in which the egg is laid is curious. As the soft, moist egg emerges from the cloaca, the female rolls it out of the venter by pressing her flat pelvic region into the sand and moving the posterior half of her body laterally with slow, convulsive movements. The surface of the moist egg gathers sand grains, so that the friction engendered between the emerging egg and the substrate facilitates the passage of the remainder of the egg through the venter. However, after the entire egg has emerged, the female keeps up the grinding roll of her pelvic region, until the egg is completely covered with sand and driven part of its depth beneath the sand. Still using her body, she rolls the egg to one side and completely under the sand. The location of the egg is now detected by a slight bulge in the surface of the sand. Oviposition proceeds in the same manner until a number of eggs have been pushed into the sand. These are arranged in a row under a very slight ridge of sand, and it is noteworthy that the pelvic region is still employed in handling the eggs. The female shifts her position from time to time, seemingly having some difficulty in evacuating the eggs. When all eggs have been laid, the area in the immediate vicinity of the lizard is underlaid with rows of camouflaged eggs, while the surface of the sand is more or less leveled off. At the same time, the

surface of the sand has been so gently roughened by the sidewise movement of the lizard's body that the surface sand has not been replaced by any darker sand from a lower strata, as would be the case if an animal dug a burrow or hole for its eggs, nor is there any evidence of even a slight recent excavation, as would be the case when sand is patted down. Only the dry surface sand has been used in hiding the eggs.

It would be interesting to witness oviposition in nature to see if this action is natural.—CLINTON F. SCHONBERGER, *University of California at Los Angeles, California.*

NOTES ON A CAPTIVE SCARLET SNAKE.—On September 2, 1944, the writer collected an adult scarlet snake, *Cemophora coccinea* (Blumenbach), beneath the bark of a rotting pine log in the mixed forest near Ozark, Alabama. The snake was 10.5 inches in length.

As a captive it did very well in an ordinary milk bottle containing dried grasses and small pieces of bark. When taken from this container and placed in a dish of water it never failed to drink, often holding just the lower angle of the jaw in the water.

On September 6 a bluish cast to the head was noted but there was no clouding of the eyes. This color disappeared on September 8 and during the two-day period the snake made repeated pressing movements into the palm when it was held lightly in the hand. The skin was shed entire on September 10 by hooking the cast head scutes on bark and crawling slowly out of the skin. A small amount of feces was extruded during this operation.

The body of the living scarlet snake is quite springy and stiff. When crawling on a level surface the head and neck are invariably held high after the manner of a racer. When alarmed, my specimen could move with great rapidity. It always headed for cover if available and was not observed to leave concealment voluntarily. Through the glass of the bottle it was noted that movement under cover was made by the method of crawling forward in an almost straight line, using the ventral scutes alone, with few body undulations. When at rest, the body seemed to "kink"; when the cover was suddenly removed, the position of the snake reminded the writer of a stiff, irregularly bent wire. It was never observed to lie in a coil.

All live food, such as slugs, insects, small salamanders (*Desmognathus*) and small lizards (*Eumeces*), was refused.—LT. RICHARD C. SNYDER, *94th Chemical Bn., Camp Rucker, Alabama.*

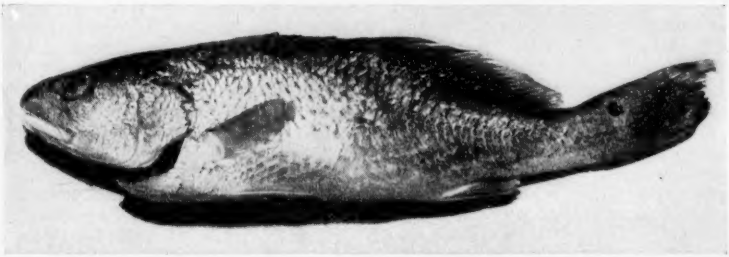
Ichthyological Notes

THE BLACK MARGATE, *ANISOSTREMUS SURINAMENSIS* (BLOCH), IN TEXAS WATERS.—The black margate is reported to extend from Louisiana to Brazil, but its occurrence in Texas waters has not been recorded. On December 7, 1939, I received a 2 pound specimen from a local fish house, which had been included in a shipment of fish from Port Isabel, Texas. Port Isabel is at the extreme southern tip of the state and presumably the fish was caught near there, probably on a snapper bank. The gutted fish weighed 2 pounds. It was between 12 and 15 inches long, but was not measured and the specimen was not kept.

On August 24, 1943, a pole and line fisherman caught a black margate 200 yards off the end of the south jetty at Port Aransas. This is about one-half mile from shore in the Gulf of Mexico, and the locality is about 200 miles north of Port Isabel. The fish measured 38.0 cm. in total length. It was sent to me by Mr. Gordon Gunter and deposited in the Houston Natural History Museum.—J. L. BAUGHMAN, *311 Peden Ave., Houston, Texas.*

ANOTHER ALBINO LAKE TROUT.—In a recent article in COPEIA (4, 1943: 253), Hazzard, reporting an albino lake trout, *Cristivomer namaycush* (Walbaum), from Lake Michigan, stated "As far as can be determined, albinism in lake trout has not been previously reported, and is believed to be rare in this species." I am now able to report a second albino lake trout approximately 17 inches in length. This trout was taken by Henry Germain, Fort William, Ontario, while trolling, on September 3, 1944, in Lake Superior, at Cloud Bay, 20 miles south of Fort William, Ontario, Canada. Mr. Germain informs me this fish was entirely white. Unfortunately it was eaten before the lucky angler realized how unusual was his catch.—ALBERT E. ALLIN, *Provincial Laboratory, Ontario Dept. of Health, Fort William, Ontario.*

ANOTHER REDFISH, *SCIAENOPS OCELLATUS* (LINNAEUS), WITH REVERSED SCALES.—In COPEIA, 1941 (3) (p. 176), the writer described a redfish, 45 cm. in total length, taken from Redfish Bay, Nueces County, Texas, on January 5, 1941, which had most of the scales on the posterior half of the body pointing forward. In brief, the posterior scales, except for the top and bottom rows, pointed forward and met the normally imbricated scales of the anterior part of the body along an irregular vertical line slightly posterior to the midpoint of the body axis. The lower margins of these oppositely pointed scales were directed upward as they approached each other and in the resulting triangular area on the sides and belly the scales pointed dorsally. The condition was a symmetrical one, i.e., both sides had the same peculiar scale pattern. It was concluded, for various reasons stated in the note (*op. cit.*), that the condition causing the reversed scales must have been present when the dermis first formed in the embryo. The specimen was not figured.



A photograph of the redfish, *Sciaenops ocellatus* (Linnaeus), showing the posterior reversed scales on the left. The specimen had been cleaned before it was acquired.

On January 4, 1944, Captain M. B. Mullinax of the Game, Fish and Oyster Commission, picked up a similar redfish, 40 cm. long, in a fish-house in Aransas Pass and brought it to me. Aransas Pass is on the shore of Redfish Bay, near where the first specimen was caught. The figure shows the scale pattern of the fish, which is similar on both sides.

Since the second fish was practically the same size as the first, the fish were presumably of about the same age when caught. It may be possible that both fish were subjected to the same peculiar external influence at the time the scale pattern was being determined, but the most reasonable conclusion seems to be that there is some hereditary condition in certain redfish of the Redfish Bay area that produces the aberrant scale pattern.—GORDON GUNTER, *Game, Fish and Oyster Commission, Rockport, Texas.*

HABITAT OF THE BLENNIOID FISH *BROTULA MULTIBARBATA* IN THE SOUTHWESTERN PACIFIC.—The revision of the species of *Brotula* by Hubbs (COPEIA, 1944: 162–178, figs. 1–2) prompts the recording of some habitat observations which I made on this genus during service in the southwestern Pacific. One of the first fishes

which I seined at Guadalcanal was identified as *Brotula müller*i by comparison with Fowler's figure (Occ. Pap. Bernice P. Bishop Mus., 9, 1932: 13, fig. 5) of this nominal species, which Hubbs synonymizes with *B. multibarbata*. This fish was found to have nocturnal habits. Considerable numbers were seen not only at the edges of the coral reefs but also in the lagoons and over smooth sandy bottoms. They were especially common around the mouth of Tenaru River where the bodies of slain Japanese were floating. They freely entered fresh water for a distance of at least 500 yards. Several specimens were preserved in the small supply of formalin that was available, and were soldered into a C-ration can along with other small, curious fishes, but the package appears never to have reached its destination. The nearest thing to a sample I saved was a letter-opener modelled out of Japanese aluminum from a six-inch specimen of the *Brotula*.

Again at Woodlark Island (called Murua on most charts), and at Milne Bay, New Guinea, I found fish which certainly appear referable to *B. multibarbata*, though they showed some variation in body coloration, particularly in mottling. In these two places specimens were blasted out of coral "niggerheads" during the day by underwater demolition men. Obviously the species, in agreement with Hubbs's suppositions, remains concealed in the coral during the day but wanders far and wide during the night.—Lt. Raymond E. Johnson, *United States Naval Radar Training School, Naval Air Station, St. Simons Island, Georgia.*

MORE LITTLE FISHES THAT PLAY LEAPFROG.—In a recent article in the *American Naturalist* (78: 451–463), Gudger has presented a most interesting collection of observations and reports about fishes that play "leapfrog." On reading this I was reminded of the observations that I had made on small fishes leaping over floating objects at Woods Hole, Mass.

Several years ago when I went for a swim at the Marine Biological Laboratory bathing beach on the shore of Buzzards Bay, I noticed some small fishes, only 3 or 4 inches long, leaping over a floating piece of straw which was 5 or 6 yards away. It was high tide and the water was calm. There seemed to be several of the little fishes jumping now from one, now from the other side of the straw. As a rule the fishes left the water several inches from the straw, and followed a graceful curve to enter the water again a few inches beyond it. Occasionally a clumsy leap would land the jumper on the straw and in a few instances, in what appeared to be a superabundance of exuberance, a fish would leap briskly out of the water near the straw but not in a direction to carry it over. This was late in August or early in September, and I left for home a few days later. I communicated with Professor G. H. Parker about the behavior, raising the question as to whether or not fishes would indulge in "play." He suggested that an experimental study should be made.

One day in the summer of 1943, at the steamboat dock near the Woods Hole railroad terminal, I noticed that here were schools of small fishes maneuvering in the water at the edge of the wharf. The water was relatively smooth. Occasionally a small fish would leap over some floating object. I collected a handful of small sticks, 6 to 12 inches or so in length and dropped them, one at a time and at intervals of one to several minutes, into the water near the fishes. As each stick was dropped, there would be a show of excitement for a moment, then one of the little fishes would jump over it, to be followed by others. Sometimes a fish would nose up to the stick as if to "investigate" it, but the jumping was done clear out of the water and not in contact with the stick. Some days later I repeated this experiment when my wife was with me, and other people on the dock watched the fishes jump over the sticks that I tossed into the water.

I made no attempt to identify the leaping fishes but they always seemed to be about the same size—3 or 4 inches long. Schools of slightly larger fishes were also in the water at the edge of the dock, but I never saw any of them leaping over floating objects; hence I judged that only one kind was indulging in the "sport." My observations appear to be quite similar to those of Breder on herrings, and those of Louis Monaco and John Germann on the "spearing" in Long Island Sound, as reported in Gudger's article.

To me this behavior suggested play and I am still inclined to believe that this is the best interpretation for the performance here described.—D. H. Wenrich, *Zoological Laboratory, University of Pennsylvania, Philadelphia, Pennsylvania.*

REVIEWS AND COMMENTS

A SOURCE-BOOK OF BIOLOGICAL NAMES AND TERMS. By Edmund C. Jaeger. Charles C. Thomas, Springfield, Illinois, 1944: xxvi + 256, illus. $4.00.—With the decline of emphasis on Latin and Greek in education generally and perhaps especially in the education of scientists, the current generation of biologists has only a minority of scholars with any real knowledge of the languages from whose roots scientific names and terms have been coined and compounded, and from which they will long continue to be formed. Some of us have acquired a reasonable vocabulary of such roots merely by attention to the meanings of the generic and specific names of familiar animals, and have gradually learned not to hesitate over their pronunciation or stumble in spelling them. A glance at any page of Jaeger's dictionary is enough to remind us how slender such a knowledge is, and to demonstrate the value of his compilation.

The Introduction reproduces part of the introduction of Palmer's useful *Index Generum Mammalium*. It would have been useful to expand the introductory material with a little more of the rules of zoological nomenclature, to supplement the short section on the botanical rules. The usefulness of common names and adjectives derived from technical names and terms might have been emphasized. The illustrations are attractive, and by translating the scientific names in the legends, they serve further to illuminate the descriptive nature of the older scientific names. It is a little disconcerting (in 1944) to find the system of literal translations breaking down for the stink-horns.

A source book of biological names and terms is to be recommended for the editorial desk, whether of scientists or of non-scientists, and to biologists generally if they are interested in the meaning and in the correct use of words.—KARL P. SCHMIDT, *Chicago Natural History Museum, Chicago, Illinois.*

THEY HOP AND CRAWL. By Percy A. Morris. The Jaques Cattell Press, Lancaster, Pa., 1944: XIV + 253, illus. $3.50.—It is evident from the crowds that jam the reptile houses in zoological gardens the world over that there is continued room for popular works on reptiles and amphibians. Mr. Morris' book makes an excellent first impression by its excellent typography and by the general excellence of the half-tone illustration. This impression is marred by numerous minor errors in the text, mostly in nomenclature or in the use of words—regal python, for example, for reticulated python (on page 1), or "metamorphism" for metamorphosis. On more critical examination the errors of fact and interpretation prove to be too numerous to be excusable in a book intended to be useful to beginners and amateurs.

The author was well advised to avoid the complexities of subspecific classification and write, with simple binomials, about the *species* of amphibians and reptiles of temperate North America. The reviewer is flattered by what seem to be paraphrases of some of his own comments on the common snake myths, but disappointed to find no suggestions for the further pursuit of this topic, or, for that matter, of any other, by the reader whose interest is aroused by the book. This is the fundamental defect of what may be referred to as the Ditmarsian school of herpetological writing. Thus such books tend to close the doors they are quite sincerely intended to open.

In spite of the great simplification of nomenclature by the avoidance of trinomials, the author and the editors of a supposedly scientific press have fallen into curious errors in the scientific names employed. Parentheses have been placed around all of the names of the authors appended to the Latin names. W. H. Osgood's contention that the rules with respect to the use of parentheses are no longer useful is thus supported. In the legends for the illustrations the scientific names are followed by a period, separating the Latin name from that of its author. In so popular a book it might be a good device to relegate the scientific names to an appendix, in which the details of form could be checked by some authority more familiar with the details of nomenclature than a popular writer is likely to be.—KARL P. SCHMIDT, *Chicago Natural History Museum, Chicago, Illinois.*

CONTRIBUTIONS TO THE GENETICS, TAXONOMY, AND ECOLOGY OF *DROSOPHILIA PSEUDOOBSCURA* AND ITS RELATIVES. By Th. Dobzhansky and Carl Epling. Carnegie Institution of Washington Publication 554, 1944: 1-183, 24 figs., 4 pls.—Those taxonomists who have followed the work of Dobzhansky on the genetics of natural populations will find in this volume a synthesis and extension of earlier work. Although the methods by which this analysis has been carried out are to a large extent applicable only to *Drosophila*, the results and conclusions are of prime importance to all interested in evolution and taxonomy.

The monograph in question is divided into three parts. Part 1 by both authors, is a compilation of data on the taxonomy, distribution, and ecology of *Drosophila pseudoobscura* and its relatives. This species was formerly divided into Race A and Race B, but the name *pseudoobscura* is now restricted to Race A and *D. persimilis* is proposed for Race B. The morphological difference between these species is so slight that their distinction would never have been achieved by the usual methods of taxonomy. Dobzhansky and Epling regard species as "the stage in the process of evolutionary divergence at which an array of populations once actually interbreeding or capable of interbreeding has become split into two or more reproductively isolated arrays." Their two forms, *pseudoobscura* and *persimilis*, have become isolated to such an extent that gene interchange between the two under natural conditions is highly improbable. It therefore becomes necessary to regard them as distinct species. Part 1 also has a discussion of geographic distribution, habitat, food habits, diurnal periodicity, seasonal cycles, and migration of these flies.

Part 2, by Dobzhansky, is a discussion of the chromosome races of the two forms. Subspecies are defined as "genetically distinct subdivisions of species which replace each other in space" and to describe them adequately it becomes necessary "— to analyze and describe the distribution of the variable genes one by one. A system of morphological averages may well serve as an exploratory device, but a basic understanding of the principles of racial variation can come only from knowledge of the distribution and relative frequencies of variable genes and chromosome structure in a population." In an effort to begin such an analysis Dobzhansky has undertaken a study of the salivary chromosomes of larvae from many localities in western North America. The larval salivary chromosomes of *Drosophila* and certain related Diptera are unique, not only because of their size, but also for the presence of characteristic bands that make possible the identification of regions in the chromosomes. It is found that chromosomes of larvae from different localities are not always identical, and in some inversions of a portion of the chromosome have occurred. Thus in the third chromosome of *pseudoobscura* eleven different gene arrangements have been found. It is mainly with the geographic distribution of these inversions that Part 2 of the monograph is concerned. Practically every local population is found to be unique in the relative frequency of the various chromosome patterns and in addition seasonal fluctuation in chromosome types also occurs. Of exceptional interest is the finding that it is possible to determine the relation of one inversion to another, and therefore to ascertain the phylogeny of the different gene arrangements. In contrast to this genetic variation, the adults are morphologically identical throughout their range. This means that the different chromosomal patterns have no visible effect on the organism.

The relation of these findings to the problem of the nature of geographic races is not entirely clear. We are one step nearer our goal when population characteristics are described on a chromosomal basis than when anatomical characters alone are considered. However, the very fact that the species preserves morphological uniformity in spite of marked chromosomal variability may indicate that inversions are not of great importance in the formation of races.

In Part 3 Epling attempts to account for the geographic distribution of gene arrangements. Present discontinuities are viewed in the light of climatic and biotic conditions of the Pleistocene and Tertiary. The inversions may be very ancient, some of them perhaps in existence since the Miocene.—JOHN A. MOORE, *Barnard College, New York, New York.*

THE POISONOUS SNAKES OF THE NEW WORLD. By Clifford H. Pope. New York Zoological Society, New York, 1944: iv-viii, 1-47, 42 halftone illustr. (2 in color). $.50.—Clifford Pope long ago proved that he is one of the few scientists who know how to write for the layman. His popular books are widely read and the New York Zoological Society has made a wise choice in selecting him to prepare its pamphlet on the venomous snakes of the western hemisphere. The topic is not new, for the same organization issued "The Poisonous Serpents of the New World," by the late Raymond L. Ditmars, fifteen years ago (Bull. N. Y. Zool. Soc.: XXXIII, No. 3, 1930).

In no way, however, can Mr. Pope's text be considered as a rewrite. It is entirely new, up to date, and a timely contribution now that American service personnel is scattered over the New World as well as the Old. All the snakes dangerous to man are described and discussed and they are grouped geographically so as to simplify ready reference and give a quick bird's-eye conception of what kinds one might expect to find in any given area. The sections on the species peculiar to Latin America are especially welcome, since little of a popular nature has appeared in print on the herpetology of that region. A discussion of venoms and what to do if bitten adds much to the general value of the pamphlet.

None of the illustrations are new, except for the frontispiece in color; all the others appeared in the previous Ditmars publication. Most of them are excellent, but there are several, notably those depicting the copperheads, the coral snake, and the head of the sidewinder, which should have been replaced with better illustrations of the same species.

There is little else to criticize. Many lay readers may find the use of scientific names a bit confusing since the treatment is binomial throughout most of the text, whereas trinomials appear under a number of the illustrations. A paragraph or two about what subspecies are and how they are designated would have corrected this minor defect. Some herpetologists will not agree entirely with the recommendations on how to treat snake bite. A slightly different layout of the pamphlet would have permitted the use of the three blank pages—two at the beginning and one at the end—for treatment and illustrations of the two species of *Heloderma*, thus making the subject inclusive of all the dangerously poisonous reptiles of the western hemisphere.

It is hoped that sales of this very useful booklet will be brisk enough to encourage the New York Zoological Society to issue a companion volume by the same author on the poisonous snakes of the Old World. This would be especially appropriate inasmuch as Mr. Pope is one of the pre-eminent authorities on the herpetology of eastern Asia.—ROGER CONANT, *Philadelphia Zoological Garden, Philadelphia 4, Pennsylvania.*

EDITORIAL NOTES AND NEWS

Honor Roll

ADDITIONS and changes in the list of Society members in the U.S. armed services are: W. M. MORTON, U.S. Navy; GARTH MURPHY, Army Medical Corps; PVT. OWEN J. SEXTON, U.S. Army.

Friends of LILLIYAN STEWART, of Waycross, Georgia, famous for her efforts in behalf of toad conservation, will be grieved to learn of the death of her son, Pfc. Stanley Stewart Morgan, killed in action in the south Pacific.

W. ROBERT MARTIN, who has been serving as an officer in the Canadian Air Force, as a specialist in aviation psysiology, has received his release from military service. He has accepted a position with the Fisheries Research Board of Canada and is to work at the Atlantic Biological Station (St. Andrews, New Brunswick) on the fishery biology of the cod.

News Notes

DR. PAUL R. NEEDHAM recently resigned his position in the Fish and Wildlife Service, in which he supervised federal fisheries research in California and adjacent regions, from headquarters at Stanford University. He is now serving as Director of Fisheries for the Oregon State Game Commission, at Portland.

DR. KENNETH R. DOAN, formerly Research Associate at the Franz Theodore Stone Laboratory of the Ohio State University, is now an Associate Biologist with the Fisheries Research Board of Canada. Dr. Doan is engaged in studies of fisheries problems, particularly the infestation of whitefish by the tapeworm *Triaenophorus crassus*, in the Prairie Provinces and the far north, and may be contacted through the Department of Fisheries, Ottawa.

DR. DAVID H. THOMPSON, formerly with the State Natural History Survey of Illinois, is now serving as Zoologist in the newly created Conservation Department of the Cook County Forest Preserve District with headquarters at 536 No. Harlem Ave., River Forest, Illinois.

The Board of Directors of the San Diego Society of Natural History gave a luncheon, on Nov. 3, 1944, in honor of a returned hometown boy—DR. CARL L. HUBBS.

DR. GERALD P. COOPER, formerly a member of the Department of Zoology of the University of Maine, has joined the staff of the Institute for Fisheries Research of the Michigan Department of Conservation, at the University of Michigan.

DR. WILBERT M. CHAPMAN is back at work in the California Academy of Sciences after several months fishery service in connection with the military operations in the southwest Pacific.

A year's survey of the fishery resources of Chesapeake Bay, initiated by the Chesapeake Bay Fisheries Commission, will be financed by the General Education Board of the Rockefeller Foundation. The study is to be carried on by DR. GEORGE W. JEFFERS, Professor of Biology of the State Teachers College, Farmville, Virginia.

DR. VADIM D. VLADYKOV is now serving as Biologist of the Department of Maritime Fisheries of Quebec, with headquarters in New York City.

MRS. MARIE POLAND FISH began work as senior scientific aid in the Division of Fisheries, U.S. National Museum, on December 4, 1944. Her appointment is for the duration of the war, and she has been assigned to the difficult task of cataloging the Philippine collections. The following persons are also engaged in ichthyological work in the National Museum: DR. SAMUEL F. HILDEBRAND and ISAAC GINSBURG, both on the staff of the Fish and Wildlife Service, the former working on Peruvian and Panamanian fishes, and the latter on American gobies. On the Museum staff DR. LEONARD P. SCHULTZ is continuing his study of Venezuelan fishes, DR. ROBERT R. MILLER, associate curator, is engaged largely in identifying the tremendous backlog of accumulated specimens, and EARL D. REID, senior scientific aid, is working on the skeleton collection.

The Government of Venezuela has turned over to the TROPICAL RESEARCH DEPARTMENT of the NEW YORK ZOOLOGICAL SOCIETY a building, Rancho Grande, to be used as a research laboratory. It is west of Caracas, ideally situated on a mountain top in the midst of the undisturbed jungle of one of the Venezuelan national parks. DR. WILLIAM BEEBE and his staff will spend six months at the new laboratory studying the conservation of wild life in the tropics and the habits of jungle animals, and will give a series of lectures on natural history in the larger cities of Venezuela.

Request

THE LIBRARIAN of the HOUSTON MUSEUM OF NATURAL HISTORY, Houston 2, Texas, is attempting to build up a collection of papers on natural history subjects, and will appreciate receiving pertinent publications.

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